Light and Lighting

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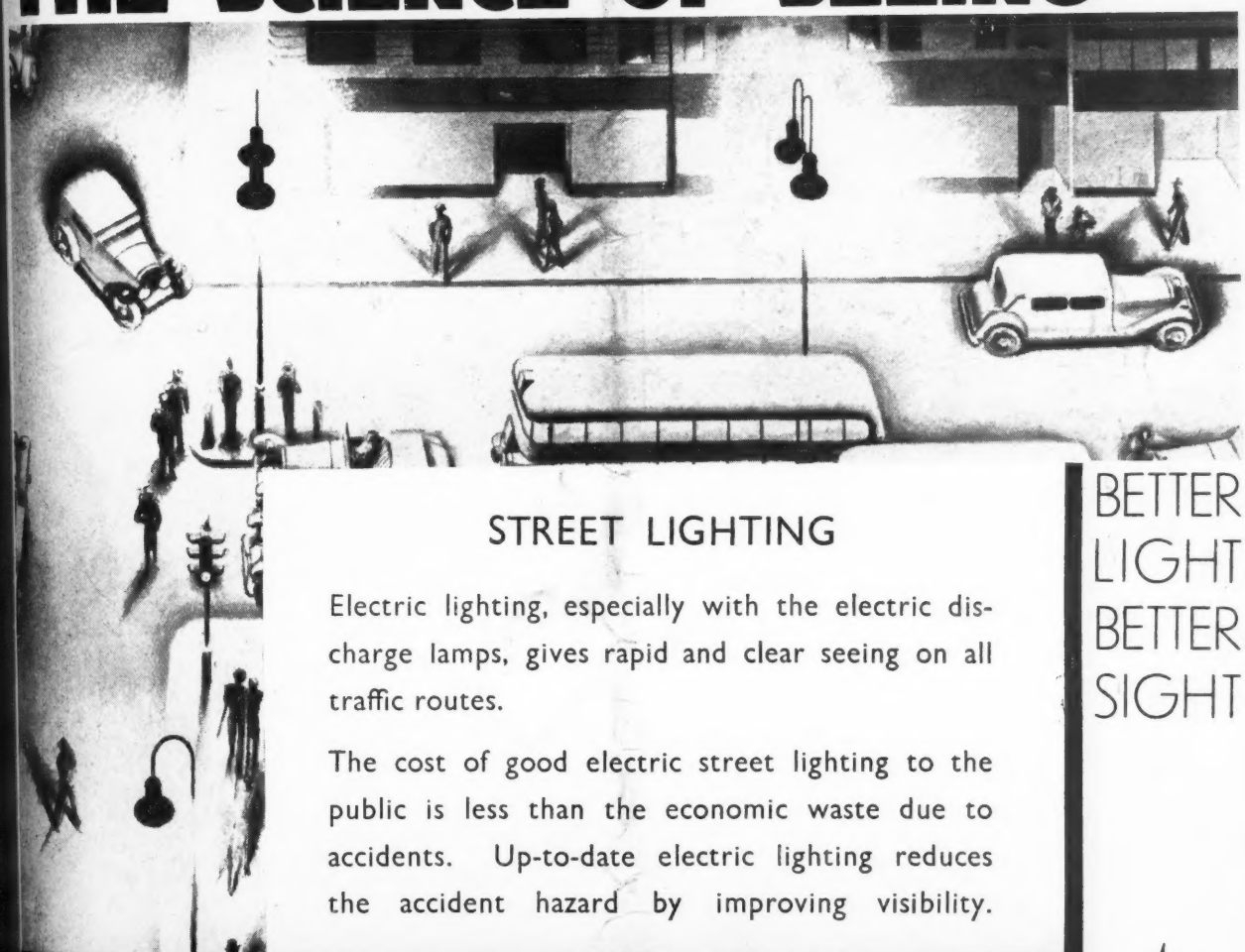
THE SCIENCE OF SEEING



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THE SCIENCE OF SEEING

SEEING IS A PARTNERSHIP OF LIGHT AND VISION

BETTER LIGHT BETTER SIGHT

In bringing the importance of eyesight preservation before the electrical trade and allied professions the E.L.M.A. Lighting Service Bureau is performing a useful service to the community as a whole. Our eyes are designed by Nature to see most comfortably under the high lighting intensities of daylight and my advice to the public is to visit an Optician at the first sign of eye trouble. But remember, glasses are not a cure for bad lighting, just as good lighting is not a substitute for glasses. Both are necessary. —O. W. DUNSCOMBE, F.B.O.A., F.S.M.C.
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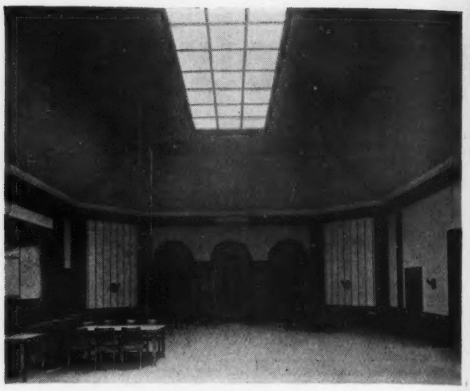
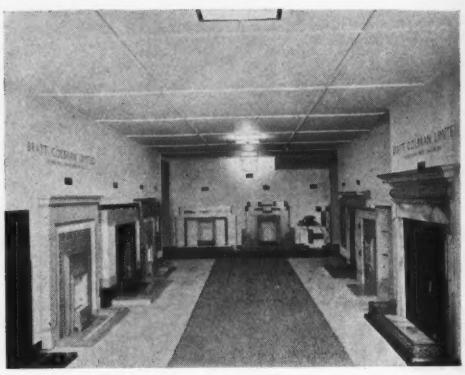


A laylight, 270 ft. super., in West Sussex County Hall. Only 3 lamps are used. (Architect : C. G. Stillman, Esq., F.R.I.B.A.)



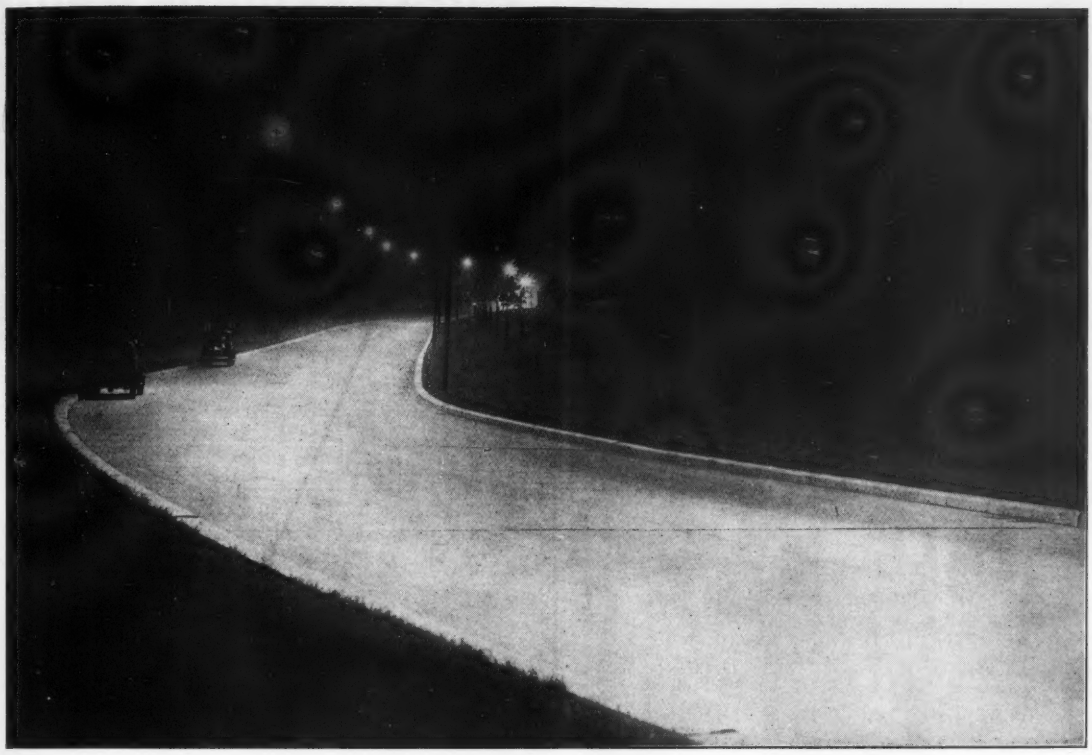
The Fireplace Section at the Building Centre, illuminated by means of G.V.D. one-bulb units.

Only thirty lamps are used in this impressive installation in the offices of Odhams Press, Ltd. (Architects : Messrs. Yates, Cook & Darbyshire)

The Park Lane Showrooms of Car Mart, Ltd. Each of the ceiling units, which are 17 ft. above ground level, contains a single 200-watt lamp.

R. M. S. "Queen Mary." G. V. D. lighting is installed in the 1st Class Swimming Pool and Gymnasium. G.V.D. lighting offers special advantages for marine work.

FIVE TYPICAL INSTALLATIONS by G.V.D.



Derby's "Golden Highway" of Safety

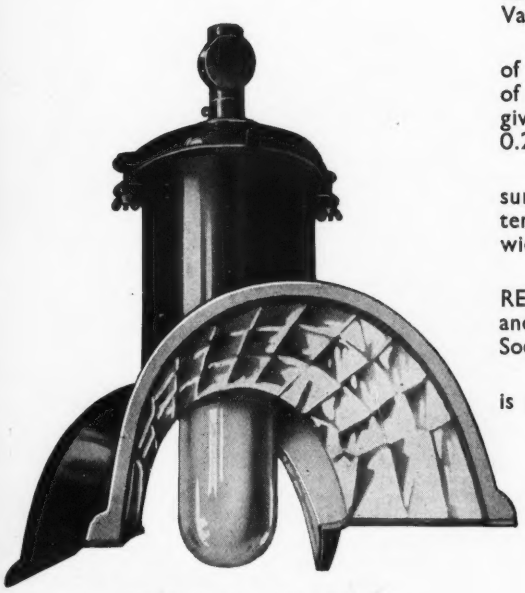
THIS photograph, which is quite untouched, shows the high degree of illumination and visibility obtained on the "Broadway" at Derby, by means of REVO "Magnalites" and Philips "Philora" 90 watt vertical Sodium Vapour Lamps.

The installation approaches almost to Class "D" of the B.S.I. Specification No. 307 with a mean intensity of 0.179 F.C., and a diversity of no more than 2.1 to 1, giving an average illumination on the road surface of 0.267 F.C. without the slightest semblance of glare.

The fittings are mounted 25 feet above the road surface, from adjustable brackets on steel poles, extending to support the units centrally over the 30 foot wide concrete roadway at 44 yard intervals.

This is only one of the many similarly successful REVO Sodium Lighting schemes throughout the country and is sufficient testimony to the efficiency of REVO Sodium Lighting Equipment.

A wide range of REVO Sodium Lighting Fittings is now available. Write for particulars.



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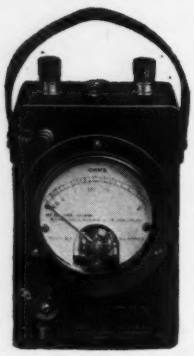
Small size—fits the pocket.

Extreme accuracy at 1 ohm mark.



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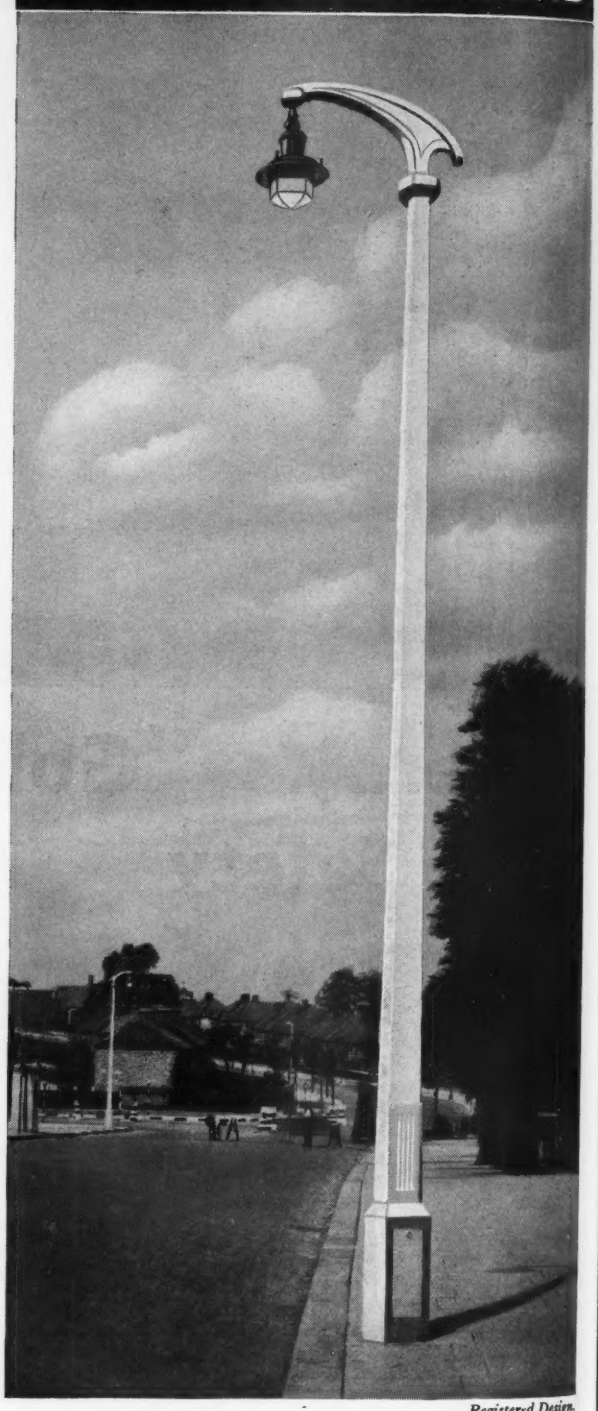

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Automatic Public Lighting Equipment GAS and ELECTRIC

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SIEMENS "COILED COIL" ELECTRIC LAMPS
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Incorporating "The Illuminating Engineer."

Light and Lighting

Official Journal of the Illuminating Engineering Society.

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Lighting the Roads of Britain

JUST a year has elapsed since the Interim Report of the M.O.T. Street Lighting Committee was issued. The Final Report is yet to come.

But it is already clear that the chief problems of road lighting are linked up with Uniformity.

We need Uniformity of Brightness on the Road Surface—absence of "pools of darkness." We should have a Uniform Standard, applicable along the length of important arterial roads passing through the areas of many different local authorities.

The Lighting of London, with which over thirty different authorities are concerned, is a problem in itself.

Every city of importance should have the services of a properly trained and efficient public lighting engineer who should not be attached to the local gas or electricity department but should occupy an independent position—a rare condition at the present time.

Towns and areas unable individually to afford the services of such an expert should be grouped together.

Grants from the National Exchequer may be needed to meet the cost of adequate lighting in many such cases.

Some form of Central Authority, with power to make such grants and to supervise the lighting of the roads of Britain, must be developed. There is no other way to ensure a uniform plan of action.

Illuminated Pedestrian Crossing Studs—Illuminating Engineering Laboratories for Cinema Work—Lighting Without Glare—The Coming Coronation Festivities—The I.E.S. in Australia.

Illuminated Pedestrian Crossing Studs

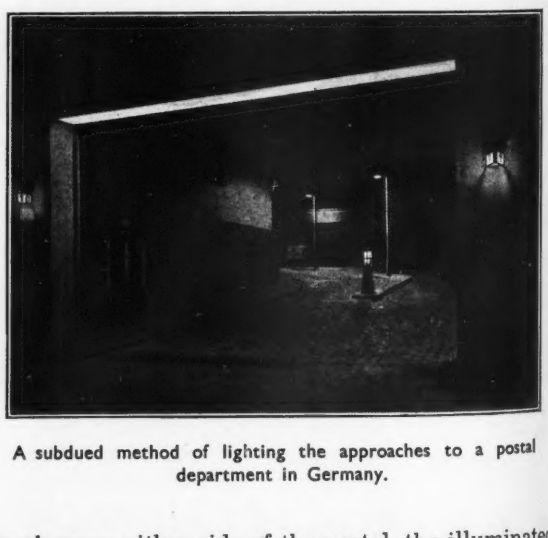
An interesting idea that is being tried out in Paris is the use of glass studs, about a foot long and capable of resisting the pressure of wheels, which are illuminated by lamps underneath. Inside each window there are red, amber, and green lamps, so as to duplicate the customary warnings of the main traffic signals. One advantage claimed for the idea is that the studs are visible when traffic lights may be hidden by somewhat bulky vehicles. One would not be surprised to see such supplementary lighting devices come into more general use on roadways. Another little point that seems worthy of study is the best method of revealing the kerb of the pavement or outlines of islands, etc. The provision and maintenance of a white border line would in itself work wonders. Special reflectors, capable of returning the beams of headlights, have also been devised. Lighting from the kerb, occasionally recommended at conferences, may seem visionary and impracticable. One would, however, hesitate to say that no field of utility will be found even for this idea.

Illuminating Engineering Laboratories for Cinema Work

We notice in the "Kinematograph Weekly" a strong plea for illuminating engineering laboratories capable of handling studio lighting problems on scientific lines. Underrun and inefficient lamps, it is suggested, often defraud the cameraman. The latter, indeed, often has his own views on lighting, which may not be those of the illuminating engineer. It is sometimes urged that taking pictures is an art, and that scientific formulae and technical data are of little practical value. We do not agree. Taking pictures is necessarily largely a question of regulating brightness in relation to photographic effect. Mr. Hopkinson has shown how valuable scientific methods may be in the photography of streets—where the lighting is outside the control of the photographer. They should be even more effective in the studio, where any desired gradations of brightness and contrast can be contrived.

Lighting Without Glare

The illustration below, which appeared in a recent issue of *Das Licht*, represents the appearance of the entrance to a post office department in Charlottenburg. It is an excellent example of the mode of lighting in which all unduly bright surfaces are rigorously excluded. Above the entrance there is a series of lamps screened by an opal glass strip, which illuminates the pavement below, but is itself of mild luminosity. The same applies to the illuminated numbers on either side of the portal, the illuminated guard-post in the centre of the road, and the screened lamps on masts, which provide the main lighting. The application of such methods in streets has been criticised on the ground that the effect is apt to be regarded as "flat," and is unpopular with street lighting committees, who lean strongly towards a "cheerful" mode of lighting. But in such cases as this there is surely much to recommend the screening of lights and the production of conditions giving freedom from glare with good visibility.



A subdued method of lighting the approaches to a postal department in Germany.

The Peril by Night—
—Good Lighting Saves Life and Limb

The accident rate is 50% greater at night.

The millions of money paid annually are but a poor compensation for loss of life and limb.

The money would readily cover the cost of first class lighting on all traffic routes.

Up-to-date street lighting reduces the accident hazard by improving visibility.

The above picture and the accompanying statements appear in a leaflet ("The Peril by Night") recently issued by the E.L.M.A. Lighting Service Bureau. The picture illustrates very clearly the value of the "silhouette-effect" in rendering pedestrians, cars, cycles, and obstructions visible by night, and the importance of good lighting in promoting safety on the roads. In defence of generosity in expenditure on public lighting it is pointed out that electric incandescent lamps and electricity both cost less than half what they did in 1920, whilst at the same time the efficiency of lamps has improved. The improvement is, of course, still more marked in the case of electric discharge lamps—over 10,000 of which have been installed for the lighting of traffic routes in Great Britain since their introduction two years ago.

The Coming Coronation Festivities

The Coronation of King Edward VIII. next May will doubtless be celebrated with unprecedented splendour. Certainly the event will bring a record influx of overseas visitors to London, and it is to be hoped that the decorations and lighting will be well worthy of the occasion. The floodlighting during the Silver Jubilee last year should serve as a rehearsal. No doubt the display next year will be on a greater scale; but will there be sufficient ingenuity, skill, and forethought in the lighting? It is reported that Mr. G. Grey Wornum, the well-known architect, is to be asked to supervise the street decorations in Westminster; if so, we may look forward to something more artistic than in the past. One hopes that the lighting of public buildings—and possibly the parks—will be regarded as a national responsibility and not left to private enterprise. One feature of last year's display —the unprecedented crowds which caused certain sections of the lighting to be cut off prematurely—will be remembered. It is perhaps worth suggesting that spectacular lighting, which then caused crowds to congregate at inconvenient spots, could equally well be used as a counter-attraction to divert them to other areas.

The I.E.S. in Australia

Some time ago we mentioned that the idea of devoting an evening to a display illustrating progress in illuminating engineering, which has proved such a popular feature in this country, has also been taken up by the Illuminating Engineering Societies in Australia. From "The Australian Engineer" we see that the Section in Victoria recently arranged an "Exhibition Night," which seems to have gone off very well. Amongst the objects exhibited were a new type of flash lamp suitable for amateur photographers, shown by Mr. Howell; a smoke alarm relay, based on the use of a photo-electric cell, demonstrated by Mr. L. Doyle, the "Study Lamp," which is evidently becoming as familiar an object in Australia as in this country, and various special forms of lanterns for use with electric discharge lamps. A final item of interest was the G.E.C. street surface brightness meter, which was shown before the I.E.S. in London last year. We hear that both the two societies in Australia are still going strong. Is there any chance, we wonder, that some of their members may visit the Old Country during the Coronation festivities next May?

Light in Daily Life

(I) Light and Civilisation

The Earliest Illuminant: The Camp Fire—Torches and Pine Splinters—Primitive Needs and Little Light—The Coming of the Candle—Lamps Burning Mineral Oil—The Advent of Gas Lighting—The Incandescent Mantle—Early Electric Lighting—Metal Filaments—Electric Discharge Lamps — Illuminating Engineering—How Lighting Has Changed—Artificial Light for Study and Recreation.

The earliest illuminant was the natural light of the Sun and the Camp Fire.

A CRITERION of civilisation has long been sought by historians. Skill in industry, knowledge of the arts, music, and philosophy have all been appraised and adopted. There is, however, one field, at once an art and, in some degrees, a science—the application of artificial light—that might well be applied as a yard-stick. As civilisation has progressed, advances in knowledge, social welfare, and enlightenment and in methods of illumination have kept step. Lighting has done much to satisfy the needs of mankind, but it has also served to develop them. Doubtless it met the needs of the scholar by enabling him to prolong his hours of study; but doubtless, also, it caused many people to acquire a zest for reading who would never otherwise have done. Surely the production of printed books must have stimulated efforts to improve artificial lighting—or was it these improvements that led to a keener and more widespread desire to read, and hence ultimately to the discovery of the art of printing?

However this may be, there can be no question of the profound influence of artificial light on the work and play, the industries and the leisure of nations. It can no longer be true to say that "the night cometh when no man can work." But even more momentous has been the influence of artificial light in enabling mankind to turn its brief period of leisure—at one time exclusively devoted to eating and sleeping—to profitable account.

The Earliest Illuminant—The Camp Fire.

Primitive man, it is conjectured, had some proficiency in the making of fire, but little skill in the use of artificial light. It would be broadly true to say that he relied exclusively on the light of day. The earliest illuminant—the camp fire—was for warmth rather than light. It fulfilled one function of light. It aided social intercourse, but hardly served for even the simplest form of work.

Of subsequent advances amongst the ancients, we really know very little. It is believed that oil lamps were used several thousand years before Christ; that wax candles were probably of Phoenician origin; that tallow candles were used in the second century A.D.; and that the Chinese used natural gas lighting long before this form of illumination reached Europe. These facts, however, come to us from incidental mentions by historians and travellers, who seldom attempted to record any details. Chateaubriand; in his "Etude Historique," referring to a chance remark made by Marcellus to the effect that in the time of the Roman Emperors the streets of Antioch were as bright by night as by day, wrote in despair at the lack of any explanatory details: "He who describes war machines minutely has not thought it worth while to give any details of something that was of everyday usage." Technical journals, wherein such things are fully recorded for the benefit of future historians, are, alas, a very modern development. What would we not give for a file of a monthly "Tecnica Romana" giving an account of technical developments in the days of the Roman Empire? Caesar gave us a most exact description of how to build his bridges, but we search in vain for any details of how his palace was illuminated.

Torches and Pine Splinters.

If the camp fire was the earliest source of artificial light, the torch, the next illuminant, was derived from it. Resinous wood served as the customary source of light in remote times, and has endured up to the present age. The sale of pine splinters in bundles and the manufacture of rush-lights, burned in simple metal holders, formed the basis of local industries up to quite recent times. The origin of lamps using oils and fats is likewise a matter of conjecture. One might imagine that, like the torch, it originated from the source of heat—that some ancient of an experimental turn of mind collected some of the melted fat used by his wife for cooking, poured it into a skull, and set it alight, thus evolving the first primitive oil.

The separation of resinous and pitchy materials, burned in open braziers, and later the use of vegetable and animal oils and fats in earthen vessels or stone jars formed the basis of illuminants for many centuries. It is remarkable that the essential principle varied so little as the years rolled by. Lamps in clay, terracotta, stone, and brass used in ancient Egypt, Greece, and Rome closely resembled the "crusies" now treasured by antiquaries, but familiar in daily life in Scotland but a few years ago.

Primitive Needs and Little Light.

In considering the past one must always remember that everything is a matter of degree and that mankind has generally managed to make for himself what he requires for his comfort. It needs little imagination to picture the simple wants of our remote ancestors, who probably stayed out in the open as long as there was any daylight, and then went back to their caves or huts to sleep. What is perhaps less generally appreciated is that the needs, in regard to illumination, of mankind right on to the Middle Ages were little more advanced. The temples of the ancients, however magnificent their proportions and design, included little provision for the admission of daylight. But this applied almost equally to the castles of chieftains and nobles of comparatively recent times. The size of the windows was determined mainly by protection against "the arrow that flieth by day," but may have given occasion for "the pestilence that walketh in darkness." Their halls must have been miserably cold and dark—even when the splendour of the illumination from torches carried by occasional attendants excited admiration amongst the guests.

But here again, though, the illumination would seem to us hopelessly inadequate, it probably sufficed for our ancestors, few of whom could read, and most of whom were content with eating, drinking, and sleeping after their day in the open air.

The existence in quite recent times of a "window tax" (it was only abolished in 1851, the year of the Great Exhibition) leading to the blocking up of many windows, is a reminder of the small value placed by our immediate forefathers on the blessings of light in the home.

The Coming of the Candle.

The manufacture of candles—a natural development from the old rush lamp—was doubtless a great advance. Right through the Middle Ages and until the discovery of petroleum in large quantities about the middle of the nineteenth century, they remained the stable illuminant of the comparatively well-to-do, though the poor continued to rely on its poor relation, the rush light. One must remember, also, that, although in essential design this illuminant, like the oil lamp, remained substantially the same for centuries, there were candles *and* candles! In an early Victorian inn the typical bill "for a gentleman who called himself a gentleman," began with the item, "wax lights, 5s." On the altars of churches the finest wax candles might be seen, but in the average home only the inexpensive tallow dip was found. During the fourteenth and fifteenth centuries the design of candles was subject to detailed specification by the Guilds of Wax and Ra Tallow Chandlers, whose competitive struggles make interesting reading to-day. The literature of the times bears evidence that the improved illumination from candles had an appreciable influence on indoor recreations. A recognition of their value and costliness is to be found in the phrase, "the game is not worth the candle." A lavish display of candles was regarded as the proper way of marking a festive occasion. It is related that at a fête organised by Louis XIV., 5,000 burning candles were counted in the Hall of Mirrors and adjacent rooms at Versailles. The illumination may have been considerable, but the heat must surely have been terrific!

Lamps Burning Mineral Oil.

The more highly developed lamps using vegetable and mineral oils, such as the Argand, with its round wick, and the so-called "Moderator" lamp, introduced early in the nineteenth century, which embodied various improvements, furnished, for the first time, a convenient source of light of reasonable power. The development of petroleum on a large scale soon brought this mode of lighting within the reach of the many—an advance which doubtless proved an important factor in the social and intellectual development of the period.

More recently, portable lamps of greater power, using acetylene, or incandescent mantles in connection with vaporised paraffin, have been introduced Such lamps, like the candle and the simple oil lamp, still play an important part to-day. The advantages and utility of a *self-contained and portable* source of light of adequate power should not be overlooked, even in these days of gas and electricity. It has, indeed, been shrewdly remarked that, had it been invented in the present age, the candle would have been hailed as an epoch-making discovery—furnishing mankind with a simple, trustworthy, and inexpensive source of light, capable of being carried anywhere in the pocket, and independent of the more complicated systems of to-day, with their complexities and inconvenient liability to occasional failures!

One thing we owe to the candle, the origin of the word "candle-power," in terms of which all modern illuminants are compared and measured. The original unit, the light yielded by a standard wax candle, burning so many grains of material per hour under specified conditions, approximates in value to the "one candle-power" of to-day, even though the actual wax candle has long been superseded as a standard by electric filament lamps of special manufacture.

The Advent of Gas Lighting.

We come now to a new chapter in the history of lighting when "distributed" methods, based on the use of gas and electricity, were introduced. That certain vapours available in Nature would burn and yield light was well known. Apart from the fact that Chinese are said to have experimented centuries ago with this mode of lighting, sources of "natural gas" have long been familiar in this country. A most interesting recent development is the synthetic production of such gas, which can be stored in receptacles, carried from place to place, and applied for the lighting of factories and villages in remote areas. Here again we have a modern instance of a self-contained and portable mode of lighting likely to prove of great utility.

But it was a long step from the use of natural gas *in situ* to the manufacture of gas and its conveyance through pipes for considerable distances. Much has been written of the work of William Murdoch, "the father of gas lighting," whose factory was brilliantly lighted with gas in 1802, and of that enterprising Moravian, Winsor, whose indomitable perseverance was largely responsible for the early development of gas lighting in England.

Those who have grown up in an age of gas and electric lighting can scarcely visualise the difficulties of pioneers in these modes of lighting, and the objections raised by interested parties. Just as the introduction of tallow candles had been fiercely contested by the wax chandlers centuries before, so the introduction of gas was opposed by dealers in oil and tallow, and by others less directly affected, such as owners of whaling companies. Moreover, the whole conception of the transference of means of lighting to a distance was new. Chairmen of committees inquired incredulously, "Do you mean it can be turned on and off—like beer in a barrel?" The production of the necessary lengths of piping and their junctions was a formidable problem. There was originally no means of measuring gas and determining the consumption. A large number of gas companies sprang up, sometimes operating within the same area. Cartoons of the day complained, with some justice, of the "foul smoak" of burning or escaping gas. It is said, indeed, that the supplies of competing companies were recognisable by their distinctive smell. Employees visiting the premises of a consumer—where supplies from several competing systems might be found—would recognise their own

company's piping by smelling each in turn; and, after arranging a contract on behalf of their own company, were quite capable of connecting his pipes to the network of a rival concern!

Gradually, however, order was achieved out of chaos. Technical and administrative difficulties were overcome, and the efficiency of gas lighting advanced. The main feature of this advance has been the gradual but complete change in the nature of the gas and the mode of using it for lighting. Originally used with a slit-burner, through which it passed and was ignited, gas was valued in terms of its "illuminating power." But the introduction of that miracle of scientific achievement, the incandescent gas mantle rendered this standard futile. It is the heat-giving or calorific value of the gas that is of service for incandescent burners, and it is on this basis that gas is rated, in terms of "therms," to-day.

It is difficult to assess the value of the light yielded by the original bats-wing gas-burners. Probably it did not exceed about one candle-power per cubic foot of gas burned. Later forms of ring or slit-burners trebled this efficiency, but the original incandescent mantles increased it tenfold. With some modern low-pressure gas lamps thirty to forty, and with high-pressure gas lamps as much as sixty times the original duty can be obtained—not a bad advance in little more than a century, and wonderful in comparison with the slow progress during thousands of previous years.

The Incandescent Mantle.

The two outstanding advances during the later period of gas lighting have doubtless been the introduction of the robust and durable inverted mantles in place of those of the upright type, and the development of high-pressure gas or other equivalent methods of producing intimate mixtures of gas and air and higher flame temperature. It would seem that the limits of possible improvement by this means have been nearly reached. Nevertheless, the actual luminous efficiency of the gas burner and mantle is still relatively low, so that ample room for further advance does, theoretically, exist. One might hope, for example, that some new combination of rare earths giving a mantle with better light-yielding qualities might be devised. Very strangely, and most unfortunately, no combination more efficient than the mixture of about 1 per cent. of ceria to 99 per cent. of thoria, which was the basis of Welsbach's great discovery, has yet been found. The composition may be slightly varied or other ingredients added in small quantity to alter the colour of the light, but no means of getting any manifest advance in efficiency has revealed itself—a condition almost unique amongst discoveries of this kind.

Gas lighting, as we have seen, is an illuminant of old standing, originating at the beginning of the nineteenth century, although it was not until eighty years later (1883), when the incandescent mantle was introduced, that its full powers were realised.

Early Electric Lighting.

Somewhat curiously the invention that made electric lighting practicable—the incandescent (filament) lamp—was invented but a few years earlier than the mantle. It is true that the electric arc lamp was of much earlier origin. A primitive light of this kind visible between two sticks of carbon connected to a series of primary batteries formed one of the historic experiments of the great Sir Humphrey Davy early in the century. Arc lamps provided with mechanism were made and used by 1850, but their light was too powerful for ordinary use. The problem of the "subdivision of the electric light," as it was then regarded, was not really solved until the inventions of filament lamps by Swan and Edison thirty years later.

If the way of the pioneers in gas lighting was hard, the difficulties of early workers in the field of electricity were even greater. The flow of gas through piping could at least be pictured and understood from the analogy of water, but the characteristics of so mysterious and intangible a force as electricity could only be gradually grasped by the inventor, and were, naturally, most difficult to explain to the uninitiated. The invention of the lamp, too, was but a small part of the problem. The whole machinery of electric supply—dynamos and motors, cables, switches, and fuses—had to be developed. In this field, also, England suffered the fate of pioneers. As in the case of gas lighting, a multitude of supply undertakings came into existence, and in this case the position was complicated by the freedom of each organisation to choose its own mode of supply and voltage. Only a knowledge of the early history of electric lighting in this country can explain the singular complexity of the conditions existing to-day—when there are in existence some 600 supply undertakings in the British Isles, with as many as forty-three different declared voltages, and a great variety of different systems of charging, in use.

These difficulties, unfortunately, we have still with us, though a little is being done year by year to smooth away anomalies and bring about greater uniformity.

Metal Filaments.

In the meantime, however, progress in the actual illuminant has been substantial. During the twenty years following the discoveries of Swan and Edison carbon continued to form the sole material for filaments, and progress was relatively slow. It was not until the early years of the twentieth century that successful experiments with metallic filaments were made. It is now common knowledge that one metal, tungsten, has survived and is the material used for filaments for electric lamps to-day. This more durable material can withstand a higher temperature and can be brought to brighter incandescence than carbon, so that a higher efficiency is obtained. Such filaments, used within an evacuated bulb, similar to that used with the carbon filament lamp, gave approximately four times as much light for a given consumption of electricity. A subsequent development, the filling of the bulbs with inert gases so that the filaments could be run at yet higher temperatures and brighter incandescence without undue deterioration, led to a yet further gain in efficiency. In the case of the more powerful gas-filled (or so-called "half-watt") lamps the efficiency has been doubled once more. We see, therefore, that under favourable conditions, it is now possible to obtain from tungsten electric filaments eight times as much light as was formerly obtainable from the carbon filaments in use in the 'eighties—indeed, probably ten times as much as was obtainable from the earlier lamps of this type.

Electric Discharge Lamps.

In the case of electric filament lamps, as in the case of incandescent gas lighting, it does seem as though the limit of possible further improvement was in sight. But a new avenue of development, the use of gases and vapours which emit light when subjected to an electric discharge has already yielded most fruitful results. The recently introduced electric discharge lamps, using mercury vapour, are stated to yield roughly two and a half times as much light for a given consumption as the best filament lamps, and the sodium vapour lamps are credited with an even higher efficiency. Equally interesting are the possibilities of obtaining much greater volume of coloured light from such lamps, which offer great scope for decorative lighting. We are already drawing nearer to the ideal of being able to control completely the *quality* as well as the *intensity* of light derived from artificial illuminants.

Parallel with these discoveries in connection with lamps, there has been a steady reduction in the cost of gas and electricity, so that to-day the consumer probably obtains light at least fifty times as cheaply as did our forefathers a century ago.

Illuminating Engineering.

Equal in importance to facility in producing artificial light is the study of its applications—what is known in technical circles as "illuminating engineering." Light is to-day not only more abundant, but much more skilfully used than in the past.

"Illuminating engineering" is little more than a quarter of a century old, and has already passed through several distinct stages. Originally, attention was concentrated mainly on *efficiency*—the use of light in the most economic manner to get the desired results. To this period belongs the introduction of shades and glassware of scientific design as well as the improvement in methods of measuring light. More recently, however, greater abundance of artificial light has led to a somewhat different outlook. Many users of light—in particular those associated with shops, restaurants, and places of entertainment —are primarily concerned with *its effects*. Provided these are satisfactory the cost is almost a secondary consideration. Lighting to-day tends to be regarded more and more as an art, instead of merely as a convenience.

If all its ramifications are considered, the lighting industry is revealed as undoubtedly one of the greatest as well as the most vital in this country. Artificial light, and the lamps and fittings which furnish it, are essential to every process and to every industry. With really adequate artificial lighting almost all industrial processes can proceed at night as well as by day—in some cases even better, seeing that artificial light, unlike natural light, is completely under man's control, and can be exactly adjusted to his needs. Without artificial light the vast transport system of such a city as London would be brought to a stop. Night-life, as we understand it to-day, would cease to be.

How Lighting Has Changed.

In conclusion, a few examples may be quoted to illustrate the changes in lighting that have occurred within little more than a century, and their profound influence on daily life.

Firstly, consider the contribution of light to the safety and order in the streets. The powerful street lamps in use in Pall Mall to-day are credited with something like 5,000 candle-power each. The first gas lamps used to light this same street in 1810 were stated to yield a light equivalent to 3-candle-power! Yet these lights were regarded as giving a wonderfully brilliant display. And they were, in fact, immeasurably brighter than the old "Parish" oil lamps which they superseded.

The oil lamps originally used in early railway coaches were doubtless regarded as a marked advance on the conditions in stage coaches (in which no one can have attempted to read by night). Yet it can be shown that the illumination derived from them was not a twentieth of that available in the average railway carriage of to-day, and probably not one-hundredth of that in some of the coaches of London's tube railways, which are exceptionally brightly lit. Many people can well remember the days when supplementary candles for the use of first class passengers (and occasionally also pneumatic contraptions for attaching them to the windows!) could be bought at railway stations.

Artificial Light for Study and Recreation.

Abundant light has also brought the means of study within the reach of all. Only the fortunate few enjoy much leisure during periods of daylight, especially during the short winter days of northern latitudes. There is no longer occasion for the efforts of the poor students of literature, who conned their books by candle light or even the dying glow of the hearth. The public library of to-day is available in the evening, the only time when most people are free to make use of them, and there has been a commendable recent movement towards similar facilities in picture galleries.

Artificial light, which has done so much to render night journeys tolerable and to make night work feasible is an essential element in almost every form of evening recreation or entertainment. In the olden days the few theatres were almost the only form of night entertainment. To-day not only do theatres multiply exceedingly, but the cinema and concert hall, cabarets, public dances, and card parties, speed track and greyhound racing, flood-lighted football—all form varieties of entertainment dependent on artificial light.

In exhibitions and pageants, artificial lighting tends to play an ever increasing role—at the Panama-Pacific, Barcelona and Paris exhibitions, it proved a dominant source of interest. Such spectacles as the Military Tattoo would be impossible without its aid.

Lastly let us not overlook one most important function of artificial light—its value for giving information. Illuminated signs not only form one of the most potent forms of advertisement, but instruct us in countless ways, marking the destinations of trains in railway stations, warning the user of the streets, and enabling the position of useful buildings to be recognised from afar.

(a) Highway Lighting Only.

(b) Automobile Headlights Only.

Fig. 1. APPEARANCE OF PEDESTRIAN AND BRICK AT DISTANCE OF 100 FEET (WET PAVEMENT).

Motor Car Headlights— —A Help or a Hindrance?

These four telling illustrations were presented by Mr. Arthur J. Sweet in a paper on "Fundamentals of Rural Highway Lighting," recently presented before the Illuminating Engineering Society in the United States. The topic here discussed is only one amongst many treated in Mr. Sweet's paper, which readers interested in street lighting would do well to study. (See Trans., Illum. Eng. Soc., U.S.A., May, 1936, No. 5.)

It is somewhat unfortunate that at the present moment, when so much is being said and written on the need for better street lighting, the views of the motorists and pedestrians are apt to be sharply divided.

The latter are anxious to remain amongst the living as long as possible. They are therefore anxious to be a bold and evident object on the highway. They usually put more faith in public lighting, than in the headlight of the motorist—the latter a two-edged weapon in view of its glare which is apt to paralyse and confuse possible victims.

The motorists, however, are apt to deride the value of street lighting and are prone to pin their faith to their head-lights. In so doing they are perhaps following, in part, the same instinct that for long caused factory workers to stand out for local lights under their own control. Like them, motorists are often guided by the belief that the "general lighting" is insufficient and even ill advised. A motorist will usually admit that really good lighting is helpful—but he will add that poor lighting is worse than none!

In this he has some justification. Pronounced patchiness and the "pools of darkness" occasionally censured by coroners are undoubtedly dangerous. It is now admitted that objects on the roadway are necessarily seen mainly by virtue of their contrast with the bright road surface. It is all important, therefore, to make the roadway as uniformly bright as possible so that objects not only become visible, but remain so and do not suddenly fade out of sight as though by a conjuring trick.

The great point to be noted, however, which Mr. Sweet's photographs most distinctly reveal, is that whilst at moderate distances (up to 100 feet) the headlight is no better than good street lighting, at greater distances (200 feet or more), it is usually very much less effective. Unfortunately, too, the headlight is engaged in doing the opposite of what the highway lighting effects—in other words, the processes revealed in Figs. 1 (a) and 1 (b) above tend to cancel one another!

It might well be urged, therefore, that wherever effective public lighting is provided, as in the main streets of most cities in this country, headlights should not be used; whilst on rural highways, if adequate public lighting cannot be provided, it would perhaps be better to recognise frankly that headlights are necessary, and to avoid any form of lighting which tends to counteract their effect.

(a) Highway Lighting Only.

(b) Automobile Headlights Only.

Fig. 2. APPEARANCE OF PEDESTRIAN AND BRICK AT DISTANCE OF 200 FEET (WET PAVEMENT).

Lighting the Roads of Britain

The Problem and the Opportunity

(Specially Contributed)

The Technical Aspects—Seeing by Silhouette—Mounting Height and Glare—Fittings with Cut-off—Patches of Dark Roadway—Bends and Gradients—Residential Roads—Administration—Necessity for Larger Lighting Authorities.

"More efficient and uniform street lighting, with particular reference to the convenience and safety of traffic." These words, quoted from the terms of reference of the Committee set up some two years ago by the Minister of Transport, aptly summarise the aims of all those who are interested in the problem of lighting the main highways and other thoroughfares of this country.

The committee to which reference has just been made has issued an interim report which will be familiar to many of our readers, and it is noticeable that the bulk of this report consists of two sections dealing respectively with "Administration" and with "The Technical Aspect" of the subject. That this should be the case cannot surprise anyone who has had to do with street lighting problems under practical conditions. The illuminating engineer who interests himself in public lighting soon discovers that not only has he a very difficult and, often enough, ill-defined problem to tackle from the technical point of view, but he is at the same time frequently hampered by irksome administrative handicaps. There is, of course, the unavoidable limitation imposed by financial considerations, but this is common to all lighting problems as to every other field of engineering activity. The street lighting engineer's peculiar handicap arises from the almost chaotic manner in which the public lighting of this country is carried out under multitudinous local administrative bodies, ranging from parish councils to county councils. In any attempt to indicate what might be done to improve the lighting of our streets, then, it is important to bear in mind both aspects of the problem, the technical and the administrative, for progress must inevitably lag behind technical development unless the administrative difficulties can be removed, or at any rate, reduced to a minimum.

The Technical Aspect.

It is, perhaps, a platitude to say that the aim in street lighting should be to render visible to all users of the roadway anything on that roadway of which they should be made aware, either for convenience or for safety. Most people would regard daylight conditions as the ideal at which to aim, but the means at the disposal of the street lighting engineer are so limited, that it is generally quite impossible for him to attempt anything like an imitation of daylight on the street, and this being so, it would be fundamentally unsound for him to approach the problem with any preconceived ideas based on daylight conditions of seeing. He must, for instance, use comparatively few sources, widely spaced, and he must work at figures of flux per unit area of the working plane which are so low that they would be condemned as utterly useless for carrying out even the roughest of processes inside a factory or workshop. All his ingenuity must therefore be devoted to producing, under these conditions, the greatest possible degree of "visibility" on the street, i.e., to giving an observer the best chance to detect objects ahead of him on the roadway. It is generally agreed that such objects are seen mainly by the contrast which they present with their background and that, other things being equal, the greater this contrast, the greater the ease with which they can be picked up under ordinary practical conditions.

Contrast may be of two kinds, viz., colour contrast and brightness contrast, but it is only the latter which need really be considered at the low values of illumination general in street lighting. Contrast is generally defined as the difference between the brightness of the object and that of its background, expressed as a percentage of the brightness of the background, and, for the levels of brightness we are now considering, it is well known that an all-round increase of brightness increases the ease with which any given contrast (as just defined) can be detected In other words, if an object is, for example, 20 per cent. darker than its background, it can be more easily seen when the brightness of the background is 0.2 candle per square foot than when it is 0.1 candle per square foot. The only other factors which affect the ease of detection are (i) anything which prevents the observer's eye from working at its maximum efficiency (e.g., glare from the street lamps, headlights of on-coming cars, or other extraneous sources) and (ii) the effect of movement both of the observer himself and of the object. It is a matter of common observation that an object in motion, especially if the motion be at all jerky or irregular, is much more readily detected than a stationary object, and it might, therefore, be urged that requirements as regards contrast might be relaxed on this account. It must be remembered, however, that it is just as important for a road user to be able to see stationary objects as moving ones, and, in any case, the margin of additional visibility provided by the movement of most of the objects to be seen can be regarded as a "factor of safety" to offset the effects of glare, etc., referred to under (i) above, effects which it is extremely difficult to assess quantitatively.

Seeing by Silhouette.

It has frequently been pointed out that on properly lighted roads the contrast by which an object is seen on the roadway is, in nearly every case, that in which the object appears *darker* than its background. On an unlighted road, however, or on one which is insufficiently lighted, the drivers of vehicles have to rely on their headlights to reveal objects ahead of them, and such objects are then only detected because they appear *lighter* than their background. This difference is of the greatest importance, and it is, therefore, worthy of note that the Street Lighting Committee, in their interim report, recommend that "for

traffic routes the minimum standard of lighting should be that which enables drivers to proceed with safety at thirty miles per hour *without the use of headlights*" (the italics are ours). Thus, it is clear that the Committee contemplates, for all the more important thoroughfares, a standard of lighting such that objects may be detected "by silhouette" (as it is termed) with sufficient ease to enable a driver to travel with comfort and safety at thirty miles per hour. It must be the aim of the street lighting engineer, then, to produce, as far as possible, a high standard of brightness over the greater part of the roadway and certainly over the whole of that part against which a driver is likely to see silhouetted the objects which it is necessary for him to detect. At the same time, the lighting must be so arranged that these objects are not themselves rendered bright by being highly illuminated or the effect of the brightness of the street surface background in producing a high value of contrast will be lost.

The methods by which a high value of street surface brightness can be secured have been described in several papers written during the past few years.* One such method, which has been fairly extensively adopted, is to use directional equipment so designed that the maximum candle-power from the lighting unit is directed at an angle of about 10 degrees below the horizontal. The reason for this is that the majority of street surfaces, even when apparently quite dark and matte, behave as though they had a considerable degree of polish when light reaches them at or near glancing incidence. Thus, to a driver looking at a portion of the roadway some 100 feet or so ahead, the street surface appears very bright if it is illuminated by light reaching it at angles close to the horizontal (see Fig. 1). This effect is especially noticeable on a wet road surface, for then there is often a streak of bright roadway stretched between the observer and each of the street lamps ahead of him. Careful observation will reveal that the same streaks are there, though very much broadened and less well defined, on any ordinary road surface even when perfectly dry (see Fig. 2).

Mounting Height and Glare.

There is, clearly, no difficulty in directing the light from a street lamp in such a way that much of it reaches the road surface at angles close to the horizontal, but a moment's reflection will show that, unless care is taken, such a scheme will give a very glaring effect. The line of sight of a driver is normally horizontal, or only a degree or two below the horizontal. If then, the street lamps are so designed as to have their maximum candle-power close to the horizontal, the driver's vision will be seriously impaired by glare from these lamps unless they are placed at such a height that he is still at a considerable distance from them when he is in the "peak" of the beam. It follows that markedly directive fittings must be mounted at a considerable height and, further, that a fitting which is too directive, i.e., one which gives a very powerful beam of light close to the horizontal, leaving the rest of the roadway in comparative darkness, is definitely to be avoided. In the Committee's report, to which reference has already been made, both these points are dealt with quite specifically. As regards mounting height they recommend 25 feet for all ordinary installations, and in such cases the ratio of the peak candle-power to the average of the values of candle-power in all directions between 30° and 45° from the downward vertical should not, in their opinion, exceed six. This ratio, termed the magnification factor of the fitting, should not, according to the report, exceed three for mounting heights of less than 18 feet.

Fig. 1. How reflected light reaches the eye of the driver.

Fig. 2. Showing the broad streaks of brightness usually seen on the road-surface.

Fittings with "Cut-off."

There is, of course, another way in which it is possible to secure a high and fairly uniform road brightness, viz. by using a much larger number of lamps mounted lower and at much closer spacing than that contemplated for a 25 foot mounting height. Markedly directive equipment is not then required as it is not necessary to depend on the "polish" effect of the road surface and so the light need not be concentrated at angles close to the horizontal. In fact, in many installations on the continent where this system is employed, there is a definite "cut-off" at some degrees below the horizontal so that glare to the user of the roadway is much reduced or even eliminated altogether. To produce, by this method, a road surface brightness equal to that given by the method previously described requires considerably more light per unit area of roadway and so far it has not been extensively adopted in this country.

Patches of Dark Roadway.

There is one danger, common to both systems of lighting, to which a great deal more attention should be paid than has been customary in the past. This is the existence of "pools of darkness," as they have been termed. It cannot be too frequently emphasised that a street lighting installation must be judged, not on its *average* performance, but on its worst. This is emphatically a case in which "the chain is as strong as its weakest link," and super-excellence over, say, 90 per cent. of the roadway must never be allowed to compensate for dangerous conditions in the other 10 per cent. In the British Standard Specification for street lighting, some attempt was made to ensure recognition of this principle by grading streets in terms of the illumination at the point where it might be expected that the roadway would be darkest. From what has been said above, however, it will be clear that the drafting of a specification for a satisfactory street lighting system is far from easy and, in fact, it has been urged that the specification should be confined to the characteristics of the lighting fittings, leaving the arrangement and location of these fittings to be worked out for any given installation by a competent and experienced lighting engineer. There is much to be said for such a view and the matter will be referred to again in the section of this paper dealing with administration.

* See, for example, J. M. Waldram, "Road Surface Reflection Characteristics and their Influence on Street Lighting Practice." "Illum. Eng.," Vol. 27, p. 305, 1934.

Bends and Gradients.

One very cogent argument put forward by those who advocate the abandonment of any attempt to draft a specification for street lighting installations is the fact that, in most cases, such specifications are primarily applicable to straight stretches of level road. Such stretches are, they point out, the exception rather than the rule in this country, so that no specification can possibly be more than a rough guide and must be adapted and modified to suit the many special requirements of bends, gradients and the like.

Residential Roads.

The interim report of the Street Lighting Committee deals almost exclusively with the lighting of traffic routes defined as, "all those roads which form the main approaches to or traverse important centres of population, or pass through detached built-up areas, and on which there is appreciable pedestrian traffic." On such routes, as has been mentioned already, they consider that adequate lighting is that which will enable drivers to travel at 30 miles per hour without headlights. It is probably true that the lighting of such roads is the most important problem at the present time but it must be remembered that there are many thousands of miles of roads in residential areas, roads which do not carry any appreciable through traffic and where the use of headlights is probably not so inconvenient as in the case of traffic routes. For such roads a lower standard of lighting must probably be tolerated and the arrangement of the lights to give an approximately uniform brightness to the street surface is generally impossible. The lighting in such roads serves a number of different purposes. It enables pedestrians to find their way about, if properly arranged it should be adequate for police purposes, and it serves as a general guide to drivers of vehicles, although these may be forced to rely on their headlights for the detection of possible obstacles or pedestrians on the roadway. The Street Lighting Committee will, no doubt, deal with the lighting of such roads when issuing their final report but there is one difficulty which must be mentioned here. It is that of lighting a road which, although it may be regarded as a residential road in the sense defined above, nevertheless carries an appreciable volume of through traffic and may, therefore, soon need to be lighted as a traffic route. The difficulty and expense involved in making any change in the number and position of the lighting standards makes it desirable that in all such cases the probable necessity for a change to traffic-route lighting should be borne in mind when the installation is being planned. Another matter which should receive careful attention in the lighting of residential roads is the necessity for raising the general level of lighting for some length in any road entering a traffic route so as to avoid a sudden change from bright to dark in passing from the traffic route into the less well-lighted thoroughfare.

Administration.

It has already been mentioned that one of the greatest obstacles to the improvement of street lighting in this country is administrative rather than technical. In the words of the Street Lighting Committee's report, "full advantage cannot be obtained from the recommendations . . . put forward on technical grounds unless regard is had to administration and finance, by reason both of the lack of co-ordination between the numerous authorities on whom the responsibility for street lighting rests and their varying financial resources." They quote the case of 31.8 miles of a heavily trafficked Class I road, of which 21.6 miles are in built-up areas, where there are in use 19 different lighting systems, ranging from Class E to Class H of the British Standard Specification, controlled by no less than 24 different lighting authorities. The absurdity of the position as regards finance is well illustrated by the fact that to light this road adequately would, in the case of some of the smaller authorities responsible for certain portions, cost them a rate approaching 10 shillings in the pound whereas if the County Council were the lighting authority it could be done for a county rate of about 0.65d.

In view of such anomalies as this (the Committee cites others as well), it is not surprising to find the suggestions made that: (a) consideration should be given to making the lighting of classified roads the responsibility of large administrative units, and (b) grants might be made from national funds towards the cost of lighting classified roads where it is considered that such roads should be lighted.

The nationalisation of certain roads had not been proposed when the Committee's report was published, and it should certainly assist in the attainment of a more satisfactory method of assigning the responsibility for lighting the roads of this country. There are two main principles to be borne in mind. One is financial, the other technical; but, fortunately, both point in the same direction. Every authority responsible for street lighting should be large enough to make adequate lighting of the roads within its area financially practicable and, equally, it should be large enough to make it possible for the authority to secure the whole-time services of a competent public lighting engineer. It will readily be conceded that modern street lighting is a very complex subject and one which is not yet fully developed. It is not surprising, therefore, that when rival organisations, supplying different types of illuminant, make diverse claims for their respective systems, the engineer who has had no special training in lighting practice finds it extremely difficult to assess the relative values of the different advantages claimed.

Necessity for Larger Lighting Authorities.

Broadly speaking, it would seem that county councils should be the smallest authorities entrusted with the responsibility for lighting the streets in their respective areas. Even this amount of unification, however, would hardly be sufficient, and many roads would still be found to traverse areas controlled by different authorities, so that the position, although better than at present, would be far from ideal. The Ministry of Transport would, presumably, be the lighting authority for the national roads, and it might therefore be found desirable to have constituted under the Ministry some advisory body charged with the duty of co-ordinating the work of the various local authorities. Especially would this be the case if grants from national funds were made to these local authorities for the purpose of street lighting.

London.

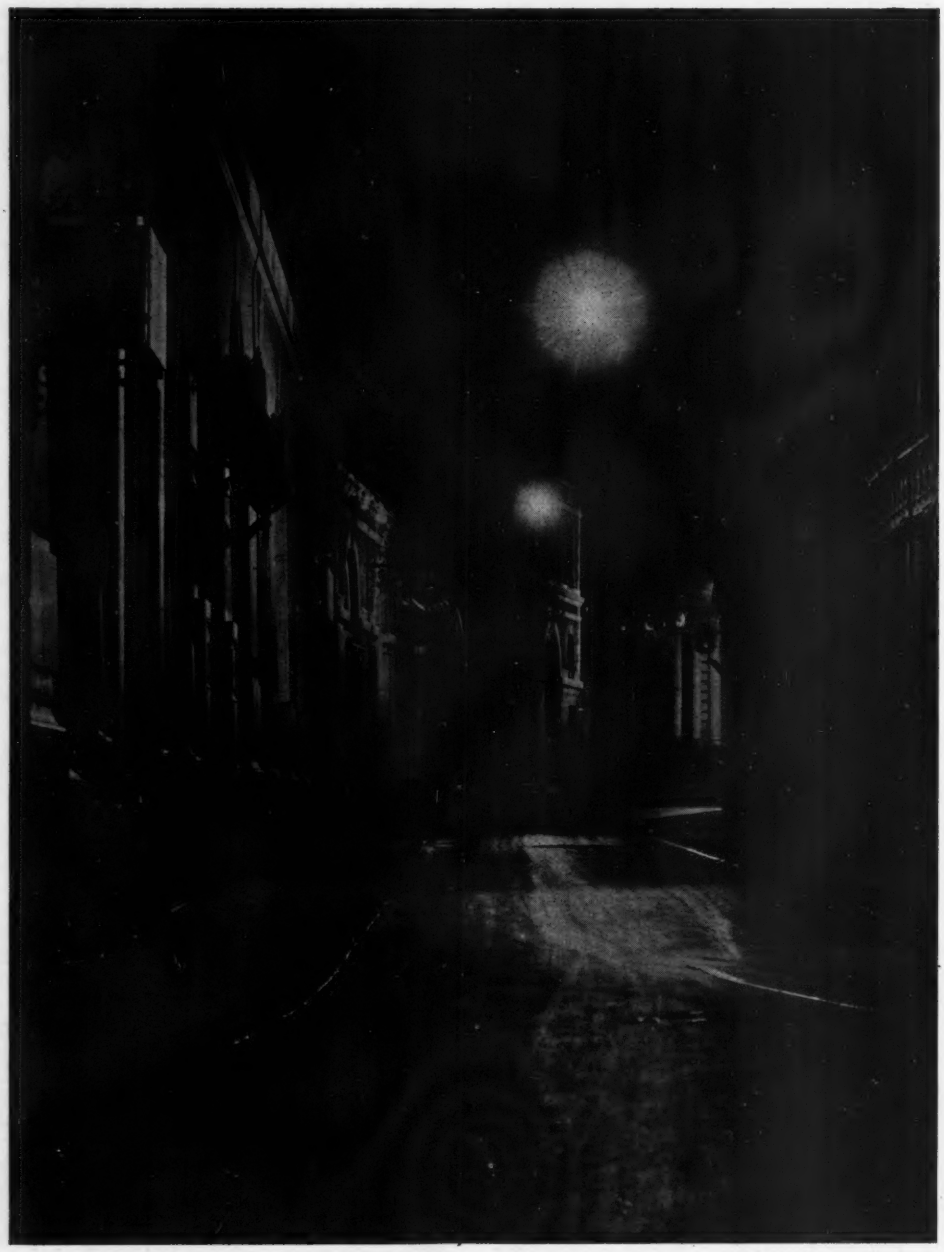
The position in London would require special consideration. At present, as pointed out by W. J. Jones*, there are no fewer than thirty-five authorities responsible for street lighting in the County of London. The result is obvious to anyone passing through different parts of the Metropolis. The Committee, in their report, mention a case in which five authorities control the lighting of four miles of roadway largely used as an exit from central London. Examples could be multiplied indefinitely. No wonder the Committee say that "the present system of administration is not conducive to the achievement of uniform and effective lighting on traffic routes."

There is plenty of interest in the subject of street-lighting at the present time. The public is alive to the need and to the advantages that good lighting brings. It is to be hoped that the Committee, in their next report, will be courageous and pay no attention to those who favour a "go-slow" policy. There are always some who urge that recommendations should be whittled down for fear they should frighten those to whom they are to be addressed. Such a policy delays progress and is a betrayal of the case which is so strong from the technical point of view. The opportunity is here; only courage is needed to seize it in the interest of the safety and comfort of all those who use our streets at night.

*W. J. Jones, "The Application of Electricity to Roads, etc." Illum. Eng., Vol. 22, p. 315, 1929.

Street-Lighting Photography

by R. G. HOPKINSON, B.Sc.(Eng.)
(Research Laboratories of the General Electric Company, Ltd.)



Lombard Street, London, E.C. Half-Tone Reproduction from a photograph produced by the Standard Representation technique. View at 18 inches with 5-500 foot-candles.

Since the publication of the writer's paper on "The Photographic Representation of Street-Lighting Installations,"* requests have been received for some general information on the technique of producing street-lighting photographs. At the outset it can safely be said that if a professional standard of photography is required, a professional photographer who specialises in the work should be employed to carry out the technique. It is also important to appreciate that if a standard representation is required as a precise engineering record of an installation, then the full technique described in the paper† must be employed. It is generally agreed that the production of an accurate photographic record does not allow room for artistic latitude, and so the aim of the record photographer is to produce not so much the most pleasant result as that which is the most accurate for his purpose. The theoretical and experimental investigations into the accurate photographic representation of street-lighting installations have indicated that the brightnesses in the installation should be represented in their original ratio by the brightnesses on the photograph, and that this being attained, any brightness on the photograph should bear the same relation to the adaptation level of the eye when viewing the photograph as the brightness which it depicts bore to the adaptation level when viewing the installation. When these considerations are satisfied the most accurate photographic record is obtained. The notes which follow are intended as a guide to those who are not yet sufficiently equipped to obtain standard representation photographs, but who are anxious to obtain for themselves good photographic representations which are not likely to give false impressions of the installations they portray.

Apparatus.

In order to obtain the best results discrimination needs to be exercised in the choice of suitable apparatus for street-lighting photography. It will be shown later that for many purposes prints of 12 in. x 10 in., or even larger, are desirable, and so negatives should be suitable for making prints of that size. The fast negative material that has to be used in order to keep exposures down to the minimum, frequently has a relatively large grain, and so enlargements of considerable magnification may not have good quality. Sizes of negative which have been found suitable are 3¼ in. x 2¼ in., quarter-plate, half-plate, and whole-plate. The significant part of a street-lighting subject covers a rather smaller field of view than that taken by the average camera lens. The long side of the useful part of the negative will in general be found to be about half the focal length of the camera lens. This means that to obtain a given size of enlargement from a negative made with an ordinary standard type of camera will require twice the degree of enlargement which would normally be expected. Consequently, it is advantageous, although not necessary, to use a longer focus lens and a longer camera extension than usual, such as an 8½ in. lens for a quarter-plate.

Some difficulty may be experienced in finding a suitable lens for street-lighting photography. As it is usually required to include sources in the photograph the lens cannot be shielded to any useful degree. Consequently it often happens that lenses that are perfect under ordinary conditions may show various forms of ghost and flare images under street-lighting conditions. Figures 1 to 4 show types of flare which may be found. The lens that shows the least flare (Figure 5) is a single achromatic lens placed behind the stop. This lens has to work at a small aperture to give good definition, and so exposures are often inconveniently long. It is quite

Fig. 1. Flare Images from a Double Astigmat Lens. (These flare images are not necessarily typical of all Anastigmat lenses.)

possible to find an anastigmat lens which is comparatively free from flare, whether working at a large or a small aperture, but it may be necessary to try one or two before a good one is found. It is a mistake to stop down in the hope of eliminating flare images. Most of these flare images are affected in size, but not in brightness, by stopping down, and the increased exposure then necessary to give an adequately exposed negative renders these smaller flare images very much more prominent.

Sensitive Materials.

As with ordinary photography it is better to select a standard set of materials which fulfil all the requirements than to use a large number of different types. The technique described in this article was developed from an investigation of a small range of material which the writer has used. There are, without doubt, other types of material that will give equally good results, but if it is desired for some reason to use these other materials, a certain amount of sensitometric investigation will need to be done. These are the reasons for giving specific recommendations in this article.

Plates and Films.

Panchromatic negative material is to be preferred for street-lighting photography, as such material is almost equally fast to light from all types of artificial light sources. With this material no allowance need be made for colour when calculating exposures. Ilford Hyper-sensitive Panchromatic backed plates and Kodak Super-sensitive Panchromatic anti-halo film for ordinary work, and Kodak Panatomic film for negatives that have to be considerably enlarged, have been used with success by the writer for some time.

Fig. 2. Reciprocal Flare Images from a Rapid Rectilinear Lens.

* Trans. I.E.S., Vol. I., No. 2, Feb., 1936, and Photographic Journal, Vol. LXXVI., June, 1935.
† Ibid.

Taking the Photograph.

In order to enable comparisons to be made between photographs of different installations it is desirable that a standard position for photographing installations should be adopted. A position 10 ft. from the near kerb, and 5 ft. above the roadway, is very suitable, as this is a rough average position of the head of a person driving a car down the road. This standard position may seem to be perilous if there is fast moving traffic on the road. It has been found that if a number of bright red lamps are placed behind the photographer, and an assistant is charged with the task of directing cars round the camera, no trouble is usually experienced.

Care should be taken to level the camera and to keep it steady during long exposures. The shutter should be opened only when the road is free from traffic, as otherwise vehicle lights will cause white streaks to be recorded on the photograph. With panchromatic materials even the red reflectors on cycles will cause streaks to appear.

Exposure.

A correctly exposed negative is essential if a good print is to be obtained. Such a negative has no large area in the image of the darker parts of the street which is devoid of detail, whilst gradation is still good in the areas of greatest density. With correct

Fig. 4. Flare Images from same Anastigmat as Fig. 3, but operating at f. 22. The flares are much brighter in relation to the rest of the picture than when the lens was used with full aperture.

exposure a negative can be produced clean and free from fog. An under-exposed negative will have areas in the shadows which look like clear glass devoid of detail, whilst an over-exposed negative will have a foggy appearance and will show no gradation in the high lights of the picture. Negatives should be examined by being held over a matt white surface illuminated to about 10 foot-candles (or three feet from a 100-watt lamp). They should not be viewed against a bright light source. If comparison is to be made between negatives, they should all be examined under the same conditions, as variations in illuminating conditions produce apparent variations in the quality of the negative.

It may be necessary to go to some trouble to obtain the experience which enables a photographer to judge correct exposure time, but modern materials allow some latitude in exposure time. A rough guide to the correct exposure is given by the following table; but in using this table it must be remembered that it is primarily the magnitude and diversity of the road-surface brightness, and, to a rather less degree, the brightness of the pathways or grass verges, that determines the correct exposure.

The exposures given in the table have not necessarily any relation to the minimum exposures that could safely be given with these materials, but are given as being indicative of the order of exposure which will produce correctly exposed negatives. Some workers use an extinction-type exposure meter.

Fig. 3. Flare Images from another type of Anastigmat Lens. Lens at f. 6.3.

Exposure Table.

Approximate Classification of installation	Exposure at f.11 with	
	(a) H.S. Pan. plate S.S. Pan. film	(b) Panatomic film
Very Good ...	20 sec.	30 sec.
Good... ...	30 ,,	45 ,,
Good average	40 ,,	60 ,,
Fair average	60 ,,	90 ,,
Poor	120 ,,	180 ,,
Bad	200 ,, or more	300 ,, or more

The exposures are given for an aperture of f.11. Relative exposures for other stops are as follows:—

Stop.	Rel. Exposure.
f. 2.8	1/16
f. 4	1/8
f. 4.5	1/7
f. 5.6	1/4
f. 6.3	1/3
f. 8	1/2
f. 11	1
f. 16	2
f. 22	4
f. 32	8

Fig. 5. Taken with Single Achromatic Lens at f. 22, placed behind the stop. There is almost complete absence of flare, but this type of lens cannot be used at large apertures.

Development.

Although the manufacturers of the negative materials recommend for each of their products developers differing slightly from each other, it has been found that one developer, i.e., the Ilford I.D.2 M.Q. developer, will give suitable results with the three materials the writer normally uses, i.e., the degree of contrast and range of tones to enable the best print to be obtained. The formula for this developer is as follows:—

Metol	1 gram.	
Sodium sulphite	75 grams	(crystals)
Hydroquinone	4 „	
Sodium carbonate	50 „	(crystals)
Potassium bromide	1 „	
Water up to	1,000 ccs.	

When making up the developer, it is desirable to dissolve all the constituents, except the metol, in the order named, in three-quarters of the total bulk of warm water. The metol should be dissolved in about one-tenth of the total bulk of warm water separately. The metol solution is then added to the other solution, and water added to make the full bulk. This avoids trouble from reprecipitation of the metol.

It is strongly recommended that the developer be used at 65°F. (18.4°C.), as a higher temperature increases the liability of chemical fog, and a lower temperature increases the development time. The times of development for the three materials are given in the table below. These times are calculated to give negatives of the type found most suitable for street-lighting photography. Such negatives are not necessarily suitable for other than street-lighting work.

Development Table

Type of Material	Time of Development at				
	55° F.	60° F.	65° F.	70° F.	75°F.
	MINS.	MINS.	MINS.	MINS.	MINS.
H. S. Panchromatic plates	7½	5½	4	3	2
S. S. „ film	8½	6½	5	4	3
Panatomic film	6	4½	3½	2½	2

To obtain even development of the negative, the plate or film should be developed in a large dish, and preferably the surface should be gently brushed steadily and uniformly with a camel hair brush, about 3 in. wide, during the process of development. Development must take place in complete darkness if fog is to be avoided.

A plain hypo fixing bath (200 gms. hypo to 1,000 ccs. water) is recommended for plates and an acid fixing bath for films. The acid fixing bath is made by adding the following solution to the above hypo solution:

Sodium sulphite crystals, 15 grams.

Add 30 cc. warm water.

Add 12 cc. glacial acetic acid, gradually.

15 gm. powdered alum.

Add 90 cc. hot water.

Allow to cool.

Mix the two solutions and add water to the whole to make 150 cc.

An hour's washing in running water, and careful drying, complete the production of the negative.

Printing.

(*a*) *Material.*

To enable prints of correct contrast to be obtained in conjunction with negatives made in the way outlined above, soft gradation printing papers must be used. The writer has used with success Kodak Soft Nikko Bromide paper, Kodak Soft Royal White Fine Grain Bromide paper, and Ilford Soft Glossy and Normal Fine Grain Lustre Bromide paper for enlargements, and Kodak Extra Soft Velox Gaslight paper for contact prints.

(*b*) *Degree of Enlargement.*

As a street lighting photograph is usually required to record the actual impression gained by an observer in an installation, attention has to be paid to details of technique which can often be neglected in ordinary photography. One important detail is the consideration of the correct distance from which to view a photograph to give correct perspective. Unless this is attended to, the bright patches and dark areas on the street surface will not assume their correct proportions in the field of view, and an incorrect impression will be given by the photograph. To obtain correct perspective, the photograph should be viewed at a distance from the eye equal to the focal length of the lens that would produce an image the same size as the photograph. For a contact print, this distance is the focal length of the camera lens, and the focal length multiplied by the degree of linear enlargement for an enlarged print. A suitable distance for normal reading and viewing is thirteen inches, and for larger photographs for display, thirty inches. The degree of enlargement that will give suitable prints from negatives obtained with a given camera lens is therefore given by

$$\text{Degree of linear enlargement} = \frac{\text{Required viewing distance.}}{\text{Focal length of camera lens.}}$$

It will be found that if the prints be viewed through a reading glass or spectacle lens of the appropriate focal length (thirteen inches or thirty inches) an improved effect is obtained, perhaps because the eye then focuses on infinity as it does in an actual installation.

(*c*) *Development of Papers.*

A suitable developer for bromide papers to give correct contrast is as follows:

Metol	1 gram.
Sodium Sulphite	30 grams (crystals).
Hydroquinone	4 grams.
Sodium carbonate	60 grams (crystals).
Pot. bromide	0.5 gram.
Water up to	1,000 ccs.

Develop for 1½ minutes at 65°F. This developer, although differing considerably from the developers recommended by the paper manufacturers for ordinary work, gives correct contrast for street-lighting work, and a full range of density. Fixing should be by the acid-hardening-fixing bath.

A suitable developer for extra soft gaslight paper to give correct contrast is:

Metol	2 grams.
Sodium Sulphite	60 grams (crystals).
Hydroquinone	8 grams.
Sodium carbonate	120 grams (crystals).
Pot. bromide	0.5 gram.
Water up to	1,000 ccs.

The potassium bromide can be omitted if cold blue-black tones are required. Develop for 30 seconds at 65°F., and fix in the acid-hardening-fixing bath.

(*d*) *Correct Printing Density.*

The accuracy of the impression given by any photograph depends on the contrast and on the density of the print. By following the technique described, the correct contrast for street-lighting photographs can be obtained, that is, the original brightnesses will be reproduced on the print in the same

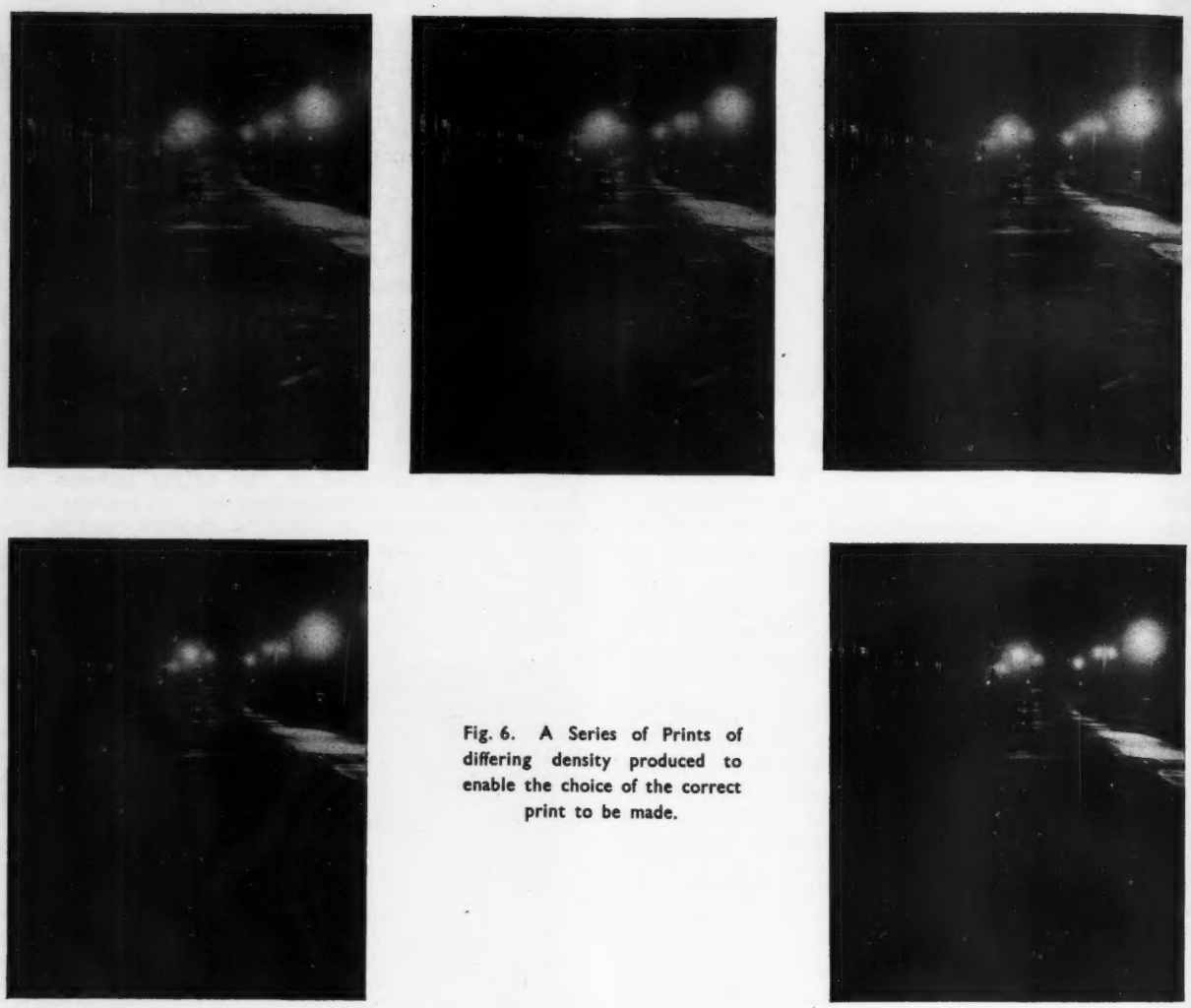


Fig. 6. A Series of Prints of differing density produced to enable the choice of the correct print to be made.

ratio. The print has also to be produced to the correct density which must be obtained either by calculation from photometric measurements in the street and on the photograph, as described in the paper*, or by a process of trial and error. This second process is as follows:

A series of prints of slightly differing density, similar to those in Fig. 6, should be made, and taken to the place on the installation from which the photograph was taken. They should be viewed under correct viewing conditions, that is, adequate illumination on the prints and correct viewing distance, and compared with the actual installation. It is very helpful in making a choice of prints to compare the detail in the shadows and in the highlights of the photograph with the corresponding areas of the original. By this means it is possible to choose the best print of the series.

If for any reason it is quite impracticable to return to the installation, then the photographer's recollection of it must be used. This is, however, a poor alternative to an examination of the print on site. If this course has to be adopted a rough sketch of the installation should be made at the time when the exposure is made, on which particulars that will aid the memory to select the best print should be noted (see Fig. 7). Close attention should be paid to the significant detail in the highlights and the shadows, and to the contrast between objects. A series of prints of different density should be produced as for the first method. They should be dried and examined under correct viewing conditions, not in any circumstances by the dark-room light. The photographer's recollection of the installation aided by the rough sketch will assist in the choice of the best print. This method should never be used before considerable experience of street-lighting photography has been obtained, because a photographer not experienced in the judgment of street-lighting photographs tends almost invariably to choose a print that is too bright, when he is not able to compare his choice with the actual installation.

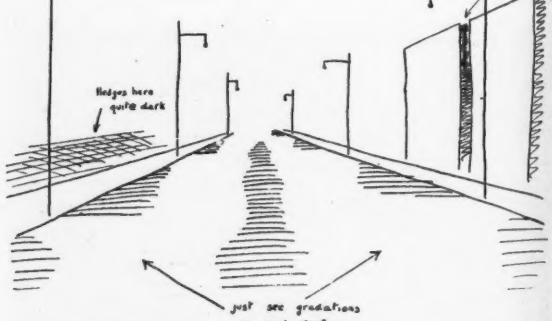


Fig. 7. Suggested form of Rough Sketch for noting details of an installation.

* Trans. I.E.S., Vol. I., No. 2, Feb., 1936, and "Photographic Journal," Vol. LXXVI., June, 1935.

Transparencies.

The production of positive transparencies for projection is rather more difficult than the production of paper prints. The faster type of lantern plate should be used in order to obtain correct contrast. One which the writer has employed with success is the Ilford "Special" lantern plate.

The developer used for these plates is the same as that recommended on page 4 for bromide papers. Development takes place in 1½ minutes at 65°F., when correct contrast is reached.

Correct density for projection is best ascertained by comparison with a correct print. The transparency, when held over a matt white diffusing surface illuminated to about 10 ft.-candles (that is, about 3 ft. from a 100-watt lamp placed immediately above the surface) should appear to have the same overall density as the correct print illuminated to the same degree. The slide when projected with a reasonably good projector, will then provide the required result.

The production of positive transparencies for direct viewing by transmitted light, can best be made to produce an effective reproduction of the original installation by adjusting the brightness of the screen behind the transparencies to give the same brightness as the brightness of corresponding parts of the original installations. The printing density should be the same as that for the lantern plate. The illumination behind the transparency should then be adjusted preferably by photometer, so that the brightness of a given part of the transparency should be the same as the corresponding part of the original installation. In this way a correct impression is obtained if the transparency is viewed in a room where the illumination is so subdued as to approximate to street-lighting conditions.

Street Lighting by Sodium Lamps

The accompanying photograph, Fig. 1, illustrates an example of a sodium lighting installation on Broadway, Derby, which should prove of considerable interest to lighting authorities. The installation approaches very nearly to Class "D" of the B.S.I. Specification No. 307, with a minimum intensity of 0.179 foot-candles, and a diversity of no more than 2.1 to 1, giving an average illumination on the road surface of 0.267 foot-candles without any appreciable glare. Unlike the lighting from mercury discharge lamps, it is not possible, by means of photographs, to give so clear a representation of the actual road conditions provided by sodium lighting, and this installation should be seen, if possible, by all who are interested in the provision of illumination of arterial roads and other main traffic routes at a minimum running cost. The 90-watt sodium units are mounted in magnalite reflector fittings 25 ft. above the road surface from adjustable brackets on steel poles extending to support the source centrally over the roadway at 44-yard intervals.

Fig. 2 is a recent photograph of Neville-street, Cardiff, which is now lighted by means of Revo reflector fittings and 150-watt Philips's "Philora" sodium lamps. As will be seen from the photograph, the resulting illumination of this residential main road, which carries a great amount of traffic to West Wales, is exceptional considering the surface of the roadway, which comprises wood blocks and bitumen. The units are fixed on one side of the roadway only, at intervals of 120 ft., the width of the road is 42 ft., and the height to light centre 21 ft. 6 in. No brackets are used in this installation, the Revo fittings being designed to clamp direct to the pole.

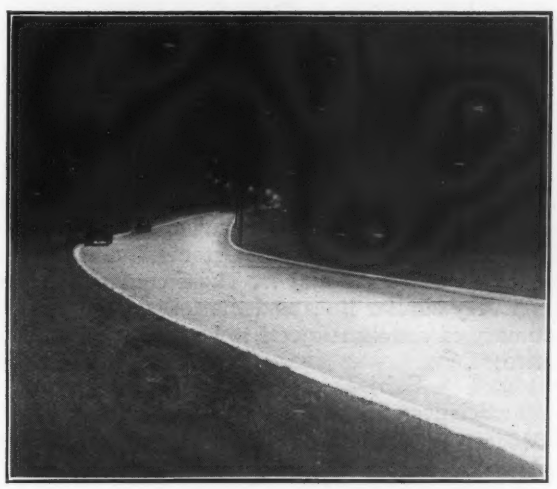


Fig. 1. Lighting by Sodium Lamps on Broadway, Derby.

Fig. 2. Lighting of Neville Street, Cardiff, by Revo Reflector fittings equipped with Sodium Lamps.

Charges for Electric Lighting

Our attention has been called to the possibility of misunderstanding arising from our remarks in the August issue on the method of charging for electric lighting. When we referred to the McGowan Committee's recommendations of a ½d. per unit for lighting, we had in mind the *running* charge, apart from any fixed payment that might be arranged in the two-part tariff, which is likely to become the usual method of charging in the future.

The Report does *not* suggest that the charge for all electricity used for lighting should be ½d. per unit, but if a running charge of this order were in general use consumers would be encouraged to be generous in consumption for lighting, the cost of which should, in such cases, prove to be very moderate.

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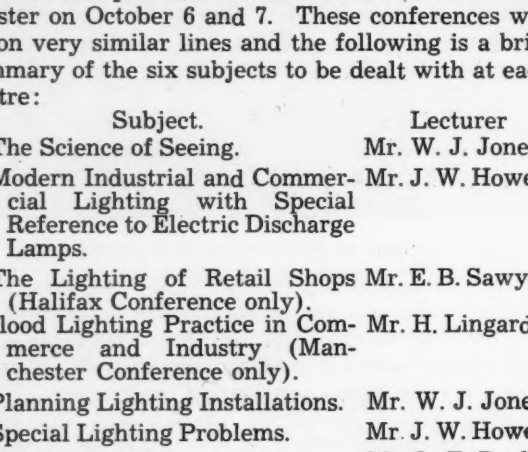
Forthcoming Conferences on Electric Lighting in Works and Offices

We have received from Mr. W. J. Jones, of the E.L.M.A. Lighting Service Bureau, particulars of conferences that have been arranged to take place in Halifax on September 30 and October 1, and in Manchester on October 6 and 7. These conferences will be on very similar lines and the following is a brief summary of the six subjects to be dealt with at each centre:

Subject.	Lecturer
1. The Science of Seeing.	Mr. W. J. Jones
2. Modern Industrial and Commercial Lighting with Special Reference to Electric Discharge Lamps.	Mr. J. W. Howell
3. The Lighting of Retail Shops (Halifax Conference only).	Mr. E. B. Sawyer
Flood Lighting Practice in Commerce and Industry (Manchester Conference only).	Mr. H. Lingard
4. Planning Lighting Installations.	Mr. W. J. Jones
5. Special Lighting Problems.	Mr. J. W. Howell
6. Electric Lamps.	Mr. L. E. Buckell and Mr. C. A. Hughes

Parade Lighting at Worthing

The above illustration is a good example of exterior shop lighting on a new parade in Worthing. The owner of these nine blocks of shops (let to 38 tenants) chose gas after seeing tests with gas and electric lighting. The installation consists of 56 6-light "Littleton" lamps lighted and extinguished by "Horstmann" automatic controllers. The Brighton, Hove and Worthing Gas Company is responsible for the installation, carrying out the whole of the fixing, supply of gas and maintenance at an agreed sum per lamp per week.



This illustration of part of a "NIPHAN" market lighting installation shows main feeding sockets fitted to a lamp standard. The "NIPHAN" system is adaptable for every type of temporary or portable lighting installation and designs will gladly be submitted.

MARKET LIGHTING with the NIPHAN System . . .

FOR some years we have been collaborating with public lighting authorities in devising temporary lighting installations for market stalls. The picture shows part of a "NIPHAN" market job, in which 6 sockets, in conjunction with a fuse board, were mounted on a lamp standard, with plugs leading to 3-way tees and suspended through-sockets.

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REGD TRADE MARK NIPHAN

The Development of Public Lighting Practice in The Netherlands

by

Ir. R. van Dijk

In order that the interested reader may have a good impression of the development of public lighting practice in the Netherlands it must be borne in mind that a treatise restricted to street-lighting developments would be just as incomplete as one dealing solely with the development of road lighting. The writer therefore considered it desirable in the present essay, not to confine himself to one of these two branches of lighting practice, but to combine road and street lighting under the common heading of public lighting.

If an interested visitor were to be conducted through the Netherlands and given an opportunity of seeing the various lighting installations executed during the last few years he would undoubtedly be struck by the fact that the development of public lighting practice in the Netherlands is mainly the direct result of the appearance on the market of modern discharge lamps.

The Influence of the Electric Discharge Lamp

In the course of history every country and every branch of art or industry has its periods of gradual development, interspersed by sudden revolutions that sweep away old truths and herald a new period of evolution on other lines. Public lighting practice in particular has experienced such a revolution in every country throughout the world, and we may already conclude that this branch of technique has emerged in a rejuvenated and regenerated condition. If the question is posed as to what the cause of this revolution may have been there can be but one answer: the discharge lamp. This lamp has led to fundamental researches on problems relating to visibility on artificially lighted roads or streets. Its efficiency has opened up fields of application hitherto inaccessible. It has, in fact, so strongly set its seal on the theory and practice of public lighting that it was felt that this article might reasonably be confined to a study of the installations executed with these lamps.

If, like the writer, one is in a position to compare the development of public lighting practice in England with that obtaining in Holland one finds that in both countries the discharge lamp has already secured a permanent and important place. The method of street and road lighting is, however, fundamentally different in each of the two countries. It is particularly noticeable that in the Netherlands the sodium lamp is assigned priority of place, whereas in England the mercury vapour lamp would seem to enjoy preference.

It may be well to give here a brief statement of the considerations that led to the Netherlands lighting system and to widespread adoption of the sodium lamp.

Fig. 1. Blended light installation at The Hague with quartz-mercury lamps of 3,000 lumens in conjunction with incandescent lamps of 200 watts. h=20 ft. a=120 ft. Total number of quartz-mercury lamps now installed at The Hague —about 100.

Discernment by Silhouette

It is the task of the illuminating engineer to aim at lighting roads and streets in such a manner that the traffic on them can proceed just as safely during the hours of darkness as in daylight. The driver of a vehicle, moving along the road at a more or less high speed should be enabled by this lighting to observe any other vehicles or any pedestrians that may happen to be on the road, or any obstacle with which he may be confronted. The driver should be able to judge promptly and with sufficient accuracy the nature, position, speed and direction of motion of any object he encounters on the road. For this it is not essential that he should be able to distinguish the colour of a motorcar he is passing or of a cyclist's clothes, and for this reason alone objects themselves need not be illuminated. If, however, we also consider other important factors, such as the nature and value of the coefficients of reflection of the road surface and of the vehicle or pedestrian observed, we find that both in England and in the Netherlands these factors lead to the unanimous conclusion that discernment by silhouette is to be preferred. We thus wish to see objects dark against the bright background of the road, just as we see them in daylight. In the interests of good visibility provision should be made for sufficient contrast between object and road background. This contrast will be increasingly intense the smaller the amount of light reflected by the object and the greater the amount reflected by the road surface in the road-user's line of vision.

Limit to Road Brightness.

The brightness of the road cannot however, owing to economic limits, be increased indefinitely. Moreover, care is necessary in order to ensure that increase of brightness level is not accompanied by factors that interfere with visibility; in such circumstances the ultimate result might be a decrease instead of an increase in power of observation. In seeking a solution of this problem we must therefore try to find such a balance between the favourable effect of high brightness of the road surface and the unfavourable effect of disturbing factors, that the final result will be the optimum one.

In English public lighting practice we see how the endeavour to give the road a high brightness by

making use of the reflecting properties of the road surface has led to the employment of fittings with pronounced radiation in a nearly horizontal direction.

In the Netherlands the aim has been to avoid, so far as possible, any effect of interference due to the points of too high a brightness in the field of vision. For this reason it is not considered permissible to use fittings that radiate in a nearly horizontal direction. The rays from such fittings, which enter the eye at a low angle with the line of vision, inevitably tend to have a detrimental effect on observation. Moreover, these are the rays which, particularly in wet weather, are reflected from the road surface as from a mirror, and give rise to streaks having a brightness which is relatively too high and therefore disturbing.

Two Alternative Systems.

There are two systems, one in purpose, differing fundamentally from each other in the use of means for attaining this object:—

In England a road surface of greatest possible brightness, even if accompanied by a certain degree of discomfort glare, is adopted;

In the Netherlands a road surface of lower brightness is preferred, all disturbing influences being avoided by the use of the "hooded" type of fitting.

It is undeniable that the Netherlands system has resulted in a smaller ratio between suspension height and lamp spacing than is usual in England. The usual ratio for good lighting on a first-rate arterial road in the Netherlands is 1 : 3 to 1 : 4. If, therefore, the lighting poles are, say, 30 ft. high, we arrive at a lamp spacing of 90-120 ft. Compared with the values applicable in England, this is certainly a small spacing. With the Netherlands system, however, larger spacing would cause too uneven a brightness distribution over the road surface.

The English system may, in view of the larger spacing of the poles, offer economic advantages. However, in the Netherlands it has been considered desirable to follow a different trend. This is a direct result of the attitude that, as explained above, one should, under all circumstances, take steps to prevent visibility being impaired by the presence in the visual field of patches of too great a relative brightness. This can be achieved by using "hooded" fittings.

In the writer's opinion it lies beyond the scope of this article to enter fully the advantages and disadvantages of these various lighting systems. The author will therefore merely describe some of the installations already executed and confine himself, as explained above, to discharge lamps.

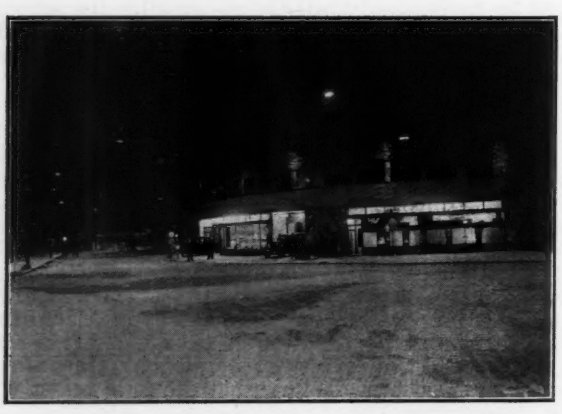


Fig. 2. Mercury light installation on Station Square at Apeldoorn. h=24 ft. 21 lamps of 1,000 lumens.

Fig. 3. Sodium Light installation on the new Bridge at Nimeguen. h=30 ft. a=90 ft. 44 lamps of 4,000 lumens.

Installations of Sodium Lamps.

In Holland the first discharge lamp made its appearance on the market in 1932 and was a D.C. sodium lamp. This lamp was soon followed by an A.C. type with separately heated electrodes, and soon afterwards came an A.C. lamp with electrodes heated by the discharge itself. Some time after the first sodium lamp the mercury vapour lamp appeared, too.

The first road-lighting installation with D.C. sodium lamps was put into service on the road-section Beek-Geleen on June 28, 1932, through the initiative of the Limburg Electricity Supply Corporation, and since then numerous municipalities in Holland have adopted sodium light on sections of arterial roads.

The first trial with mercury vapour lamps in Holland was carried out by the municipality of The Hague, whose example was soon followed by the Electricity Supply Corporation of the town of Heerlen, which installed mercury vapour lamps on the station square in that city.

If, now that discharge lamps have been in existence for some years, we investigate where mercury vapour lamps and where sodium lamps have been put into service in Holland, we notice a striking difference between that country and England. In the Netherlands mercury vapour lamps have been adopted almost exclusively in cities, e.g., on public squares and in important streets, the mercury light often being blended with incandescent light. The only object in doing this is to obtain more lumens for the same consumption of electricity. In every case, however, it was stipulated that visibility should be as great as possible at a minimum of current consumption, and where colour distinction need not be considered, sodium lamps are unanimously preferred.

Comparisons of Sodium and Mercury Lamps.

In this connection it is to be noted that, though the preference thus accorded to sodium lamps may at first have been based on mere observation, it has subsequently been found by extensive comparative tests and by the researches of Dr. P. J. Bouma* and other investigators that the sodium lamp certainly is to be preferred. In the course of these researches the various factors governing visibility were compared for each of the three kinds of light: that of incandescent lamps, of sodium, and of mercury vapour lamps. It transpired, among other things, that in the region of those particular brightness values with which such good results had been obtained, the degree of contrast between the object and the road surface in sodium light is considerably greater than in other

* "Visual Acuity and Rapidity of Observation by White Light and by Sodium Light"—"De Ingenieur," B.D. 49, pp. A. 31-34, January. 1934.

"Richness of Contrast by Sodium Light, Mercury Light and White Light"—"De Ingenieur," B.D. 49, pp. 290-294, 1934.

kinds of light. How the results of these studies have in turn also been backed up by practical tests, may be seen from the following example:—

Dr. Lulofs, Managing Director of the Municipal Electricity Supply Corporation of Amsterdam, appointed a committee about two years ago, whose task was to investigate whether a lighting installation with sodium or mercury vapour lamps could be considered permissible in the built-up area of the town, or to decide which of the three classes of light-sources: incandescent lamps, sodium, or mercury vapour lamps, was to be preferred. The persons on the committee included not only representatives of the supply corporation itself, but also the heads of various public services (e.g., street paving, building, and housing inspection departments, tree, and shrubbery services, tramway service, etc.) of the City of Amsterdam. In addition, some of the members of the Netherlands Illuminating Engineering Society were appointed members of the committee. The object of study was a part of the "Zuideramstellaan" (a big main street of southern Amsterdam). This street is bordered on either side by dwelling houses, with one or more shops at the corners of each crossroad. The road is very wide and has, in addition to two pavements, two rapid-traffic ways separated by a shrubbery in the middle. On each of the two traffic ways there are tramlines for the municipal electric tramway cars. The left-hand traffic way was lighted over a certain section by mercury vapour lamps, whilst the right-hand road for rapid traffic was lighted over the same length by sodium lamps. The suspension height, lamp spacing, method of suspension, lumen output, and type of fittings were the same on both road sections. The committee, in issuing its report, expressed the unanimous opinion that the sodium lighting was to be preferred to the mercury vapour lighting because it gave better visibility, and that, notwithstanding the confusion of colours caused by sodium light, it might certainly be considered advisable on roads like the "Zuideramstellaan," which have to cope with through traffic. This and other experiments have revealed a preference for the sodium lamp for the lighting of large arterial roads.

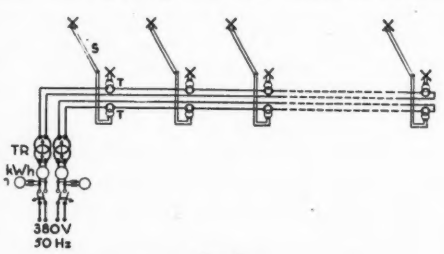


Fig. 5.

TR.	Constant current transformer.
T.	Lamp transformer.
kWh.	Electricity meter.
h.	Hour meter.
S.	Span wires.

A Striking Installation at Eindhoven.

An interesting sodium light installation well worthy of closer study is that to be found at Eindhoven. About eighteen months ago the municipality of that city decided to fit up a sodium-light installation on the portion of the busy arterial road, Eindhoven-Hertogenbosch, which lies within the municipal boundaries. This road is nearly 28 ft. wide and is bordered by trees. Behind the avenue of trees on either side of the rapid-traffic way there is partly a residential street with adjoining houses. In view of the presence of trees the suspension height could not exceed 27ft. The lighting poles are arranged in zig-zag formation on either side of the road, between

Fig. 4. Sodium Light installation at Eindhoven (series system). h=27 ft. a=110 ft. 120 lamps of 6,500 lumens.

the avenues of trees. The lamp spacing, measured along the road axis, averages 108 ft., so that the distance between two poles on the same side of the road amounts to 216 ft. Each of the 120 lighting units consists of a sodium lamp of 6,500 lumens mounted in an enamelled sheet-iron fitting. From the lighting point of view this installation is a typical example of the many sodium installations in Holland. Its special feature is, however, the method of current supply. In the Netherlands it is customary to employ the parallel system in which the lamps are connected, for instance, to 220 volts between one of the phases and the neutral wire. In Eindhoven, however, the series system was adopted, there being only a transformer station at the beginning of the 2,5 mile length of installation, so that the parallel system would have necessitated the use of very massive cables.

The circuit diagram is shown in Fig. 5. At the supply station there are two constant current transformers. Each of these transformers feeds the lighting units on one side of the road. In the ordinary way a two-core cable would probably be laid on either side of the road. In the present case, however, only one side of the road was available and hence the feeding of the two lamp-circuits was combined into one four-core cable of 4 x 0.0155 sq. inch gauge. The apparent power of each transformer is 17.6 kVA, the constant current of the secondary circuit being 6.6 amps. The secondary open voltage thus amounts to about 2,700 volts. Each transformer is capable of igniting and keeping burning seventy-two lamps.

At the foot of each pole on one side of the road there is a junction box in the main feed cable. This junction box accommodates two small lamp-transformers which have been compounded into it. The live parts of the high-tension installation thus lie entirely in the ground. Of each two lamp-transformers, one serves for feeding a lamp on this side, the other for feeding a lamp on that side of the road. For this purpose there are wires spanned obliquely over the road, connecting each pair of poles on opposite sides of the road. This system was the only one that could be employed, as there was no possibility of laying an electric cable without digging up the road. We consider this system permissible also from the point of view of appearance, especially, as in this case, the wires are hardly visible owing to the presence of the trees.

For a description of the numerous other more or less extensive sodium-light installations in the Netherlands we refer the reader to the explanatory

photos accompanying this article. Some examples are also given of the less numerous mercury vapour installations. As can be seen from the letterpress to these photos, all the installations have been designed on the principle outlined above. The screened type of fitting is in use for road lighting all over the country. Globe-band fittings have only been adopted in actual cities, where light is used more lavishly, and the effect enhanced by illuminating not only streets and squares, but also the façades of adjoining houses.

The photos, of course, only give an incomplete picture of the quality of this lighting, and do not convey

Fig. 6. Day-time photograph taken of installation of sodium lighting on national Haarlem-Amsterdam road. h=30 ft. a=108 ft. 385 lamps of 6,500 lumens.

any information as to the number of discharge lamps installed in the Netherlands. It may therefore be stated that at present the total length of roadway illuminated by discharge lamps amounts to about 135 km. There are 154 installations, from which it is evident that the average installation is of small size. The reason for this is as follows:—

Different Types of Roads

In the Netherlands a distinction is made between municipal, provincial, and national roads. The big interurban communications are practically all national roads. During the last few years these roads have been put into splendid condition, and many new roads have been laid or are in course of construction, this being done in such a manner that (as far as can be avoided) the road does not pass through built-up areas of towns and villages, but is led in a more or less circuitous route outside the built-up area. Until recently the central government as well as the provincial authorities took no steps to illuminate their roads, and it was left entirely to the municipal works to provide for lighting of streets and roads inside the boundaries of their respective municipalities. When a national road passes through the built-up area of a borough and that borough wishes to fit up lighting on that portion of the road, it can do so at its own expense, after having secured from the central Government permission to erect the plant. It was in this way that, for instance, the sodium-light installation on the road Arnhem-Velp came about As a rule, the municipal roads entering into consideration for lighting with discharge lamps are roads of exit from the inner part of a town to the outside. These road sections are therefore comparatively short, and this is the reason why a large number of relatively small sodium-light installations are met with in the Netherlands.

There are, however, well-founded indications that in the course of the next few years this state of affairs in lighting practice will be radically changed. The central government has in fact decided, thanks in some measure to a campaign on the part of the various authorities and associations concerned with road traffic, to erect a sodium-light installation at its own expense on the 8-mile stretch of national roadway between Haarlem and Amsterdam. This installation is to be regarded as an experiment, not so much from the lighting point of view, but more particularly from considerations of administration and technical economy. The importance of this step is very far-reaching, it being quite obvious that this trial will in future result in similar installations being erected on other big national roads.

The Haarlem-Amsterdam Road.

By the time this article appears in print the lighting on the road Haarlem-Amsterdam may already have been put into service or will be before long. Fig. 6 gives a daytime photo of the road in question as seen during installation of this lighting. The lighting poles are arranged in zig-zag formation on opposite sides of the road. The lamp spacing, measured along the road axis, is 108 ft., the suspension height 30 ft. The installation comprises 385 sodium lamps of 6,500 lumens, with a gross consumption of 105 watts per lamp. Feeding is effected with low tension three-phase current of 220-380 volts, in view of the supply stations in existence along the road. In this way it has been possible to make use of a low-tension cable already lying in the ground over a part of the road-section concerned.

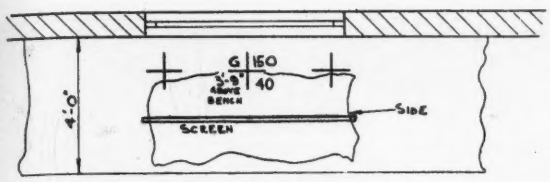
New Types of Discharge Lamps.

Finally, we would draw attention to a new type of discharge lamp which has been on the market for some months, and which offers important prospects in the domain of public lighting. We are referring to the new quartz-mercury lamp of 3,000 lumens, with an energy consumption of 75 watts in the lamp (90 watts gross), which has the same form as an incandescent lamp.

We have already explained above that in the Netherlands the use of mercury vapour lamps—often in conjunction with incandescent lamps — has in general been confined to open spaces and busy streets in cities. Until recently the smallest mercury vapour lamp available was the one with a luminous flux of 10,000 lumens and a consumption of 250 watts in the lamp. This lamp, lodged in a fitting together with an incandescent lamp of at least 300 watts to produce a light giving good colour-distinction, resulted in such unwieldy units that for this reason alone the use of mercury vapour lamps had to be restricted to important town-centres. This state of affairs has been remedied by the advent of a new mercury vapour lamp of 75 watts which, when used together with an incandescent lamp of 150 or 200 watts, gives a unit of 240 watts to 290 watts gross (Fig. 1), and thus opens up the possibility of increasing the lighting level in numerous streets. An example of such an installation already put into effect is furnished by the frontispiece of this article.

We have thus seen how it was pre-eminently the sodium lamp that rendered possible the efficacious lighting of important arterial roads in the Netherlands. The visual properties of sodium light and the high efficiency of the sodium lamp (60 lumens/watt), with consequent low current consumption, have, of course, been highly influential in bringing about this result. A great increase in the number of sodium-lit roads may undoubtedly be expected in the course of the next few years. The traffic thoroughfare is the special domain of the sodium lamp.

Moreover, the appearance of quartz-mercury lamps on the market is the prelude to an important advancement in the lighting of town-centres, especially as it seems that, thanks to this lamp, the white-light problem will be solved by means of fluorescence. In the near future incandescent lamps for public lighting may tend to be superseded more and more by white-light discharge lamps, although parallel with such developments the sodium lamp will doubtless continue to gain ground for road lighting, in view of the considerations mentioned above.



PLAN.

Fig. 1. Method of Illuminating Black Glacé Leather Skins with Overhead Diffused Light.

Inspecting Leather Skins

A Specialised Industrial Lighting Problem

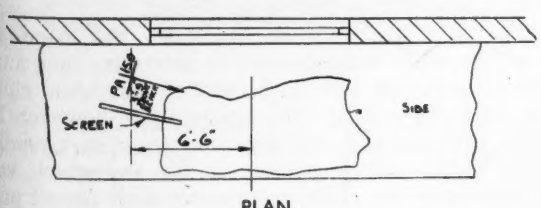
Last month we presented, by request, an account of one of the problems presented at the informal meeting of the Illuminating Engineering Society on March 31—that by Mr. H. Lingard on "Calculations with Tubular Architectural Lamps."

We are now able, by the courtesy of Mr. Howard Long, to give a similar account of the problem with which he elected to deal on that occasion.

This problem consisted in the examination of black glacé and light buff-coloured leather skins for various blemishes such as small cuts and abrasions. The black skin had a definitely glossy surface, whilst the light leather surface was substantially matt. Different conditions of lighting had accordingly to be designed in the two cases.

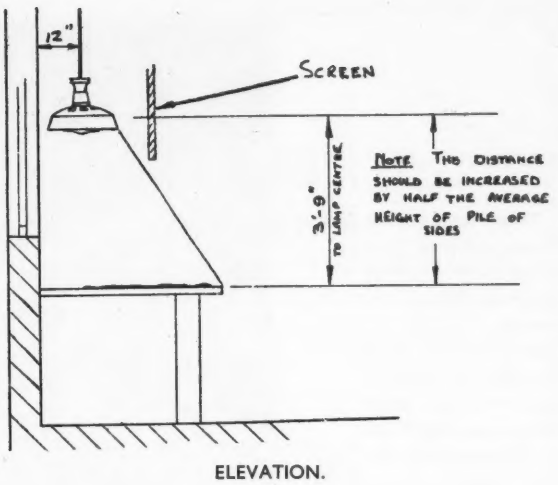
However, all the skins had all this in common—that owing to the innumerable tiny grain markings and indentations which covered them, the surfaces presented could not be regarded as plane ones, from which regular reflection would result; further, in both cases it was impossible to induce the skin as a whole to lie level!

For the black leather skins, experiments were made with a large diffusing source directly overhead, which, for the best results, should preferably be continuous for the whole length of the skin. The actual solution resolved into the use of three industrial diffusing units spaced 2 ft. 6 in. apart and mounted 3 ft. 9 in. above the skin. By placing the fittings immediately next to the back wall, it was found that a larger area of skin could be examined without change of position than if the units were mounted centrally over the skin. This arrangement produced an average illumination of 40 foot-candles.



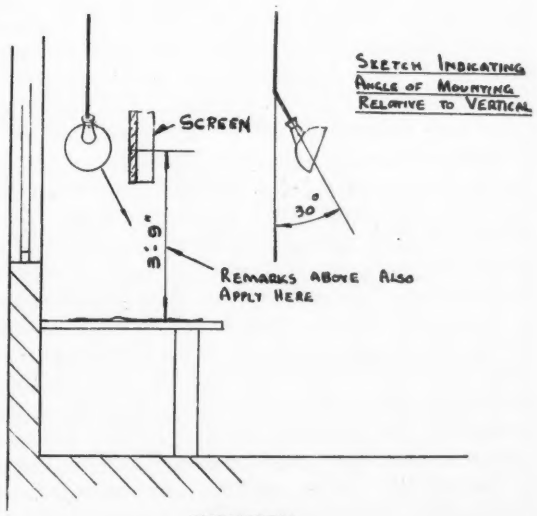
PLAN.

Fig. 2. Method of Illuminating Light-Coloured Leather Skins; Directional Lighting from the Side was found most effective.



ELEVATION.

The light skins were found to require totally different treatment. The skins are somewhat irregular in shape, but the average size is roughly 6 ft. long by 3 ft. wide. Overhead lighting resulted in a flat appearance quite useless for the type of inspection required. Directional lighting was found to be the only solution giving the desired result. A fairly wide beam was found necessary in order to cover the bench from the selected mounting height. With this type of fitting difficulty was experienced in maintaining even illumination at the end of the skin most remote from the light-source; to achieve this it was found beneficial to give the unit a pronounced backward tilt. A standard white enamelled parabolic angle reflector was adopted. The addition of a second unit spaced halfway along the bench length of the skin as a "booster" is of no advantage in this case, as the light from the lamp in the second unit nullifies the directional effect of the first. Direction, is, in fact, here of greater importance than high illumination, and a single 150-watt or 200-watt general service lamp proved quite sufficient.



ELEVATION.

This striking picture, which appeared in a recent leaflet issued by Benjamin Electric Ltd. entitled "Electric Discharge Lighting," shows the effect of dispersive type fittings with electric discharge lamps in a large machine shop. The whole interior appears flooded with light.

Courtesy: The Benjamin Electric Ltd.

Industrial Lighting—

—The Need for Systematic Maintenance

Between the moment when the fittings in a newly decorated and completely empty interior are lighted up—and the management invited to inspect the fine effect—and the moment, some months afterwards, when the room is filled with machinery, and lamps and fittings have lost some of their original brightness, much may happen!

How many people realise that the mere introduction of dark painted machinery in a room with light walls and ceiling in itself diminishes the available illumination—simply because some of the light otherwise reflected from walls and surroundings is blocked? It is a good plan to paint inactive parts of machinery a light grey, rather than black, so that they may themselves act as reflectors of light.

Electric lamps, whether filament or discharge lamps, lose candle power gradually with age. Gas mantles also deteriorate slowly with age or suffer injury through rough treatment. Lamp-bulb glassware and reflectors become dirty in time—especially in factories where the air is at once grimy and moist.

Even more serious, sometimes, is *the deterioration of surroundings*, which affects all installations, whatever the illuminant may be. Besides shades and reflectors, the walls and ceilings play their part in reflecting and diffusing light. If they become discoloured with age the illumination is bound to suffer.

Taking all these points into consideration, a diminution in efficiency of 30 per cent. in the course of a few months is not unusual in factories. To correct this, lighting experts sometimes apply a factor of safety—multiplying their calculated results by 1.43 when planning the installation, so that, after a few months, the original predetermined illumination may still be available.

But what happens thereafter? Deterioration is progressive. Ultimately, only half the original illumination may survive for the same consumption—unless something is done to "stop the rot."

That "something" is systematic and regular maintenance, including the washing of lamps and fittings, the substitution of new lamps for those manifestly old, and ultimately repainting of walls and ceilings before they become too bad for words. The cost of periodic maintenance can be shown to be considerably less than the economic value of the light saved thereby. The trouble involved is also not excessive, if the inspection is done with system.

The chief difficulty in the past has been the inability of the management to determine how much the illumination had been reduced and when cleaning up was overdue. This uncertainty, however, has been satisfactorily met by the new direct reading photometers, which anyone can use and which, with a little care, are quite accurate enough for all practical purposes. With these the manager can check the light, detect when deterioration has begun, compare one department with another, and keep a systematic check on the whole installation.

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AUTO-PHOTOMETER for demonstrating the illumination in large and small spaces. It is only necessary to expose the test surface to the illumination to be measured and to read its value direct on the indicator. No battery, comparison lamp or other accessories are employed. A minimum full scale reading of 2.5 foot-candles can be provided on the lowest range, and there is no practical limit to the maximum range.

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Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from August, Page 247)

I.—RADIATION AND GENERAL PHYSICS.

196. Transmission of Light Through a Pile of Parallel Plates.

R. A. Hull. Proc. Phys. Soc., July, 1936.

The transmission of light through a pile of parallel transparent plates is calculated by a simple method which, incidentally, gives the fractions of transmitted and reflected light at any surface in the system. S. E.

197. Time Lag in Photo-Electric Cells.

Campbell, Noble, and Stoodley. Proc. Phys. Soc., p. 589, July, 1936.

Frequency response curves of photo-electric cells are compared with oscillograph traces of the current through the cell when light is suddenly thrown on to it or taken off it. The results indicate that the time lag does not arise wholly in the processes following a single instantaneous light impulse, although low-frequency time lag must arise in great part from such interaction. No alternative theory is advanced. S. E.

II.—PHOTOMETRY.

198. Black Light and Fluorescent Materials.

L. C. Porter and J. P. Ditchman. Light, V., No. 5, May, 1936.

The various types of sources of ultra-violet radiation are dealt with, together with details of filters, reflectors, and fluorescent objects and coatings. C. A. M.

IV.—LIGHTING EQUIPMENT.

199. Skating Club at Toronto.

Anon. Light, V., No. 4, pp. 32-33, April, 1936.

Details, with photographs, are given of the lighting equipment at the Skating Club at Toronto. C. A. M.

200. Garden Lighting.

Anon. Light, V., No. 5, pp. 43-44, May, 1936.

Some suggestions for various types of ornamental housings for garden floodlights are given, together with recommendations of types of equipment suitable for different parts of the garden. C. A. M.

201. New Equipment.

Anon. Electn., 117, p. 94, July 17, 1936.

Some particulars are given of a new type of reflector unit. The reflector has two parabolic contours, as a result of which the beam width resulting from a given lamp may be varied. It is claimed that the resulting light is shadowless, and without dazzle. The fitting was originally designed for road lighting, but types are now available for floodlighting and interior lighting. C. A. M.

V.—APPLICATIONS OF LIGHT.

202. Polarised Light.

Anon. Frank. Inst., J., 222, p. 82. July, 1936.

A report is given of two materials which polarise light, and have been proposed for practical applications. S. S. B.

203. Windowless Building.

A. B. Snavely. Light, V., No. 4, April, 1936.

In a windowless building, consisting mainly of offices, the lighting unit adopted is almost totally indirect, using a 300-w. mercury tube with a 750-w. incandescent lamp. This combination was found to be most satisfactory. The fittings are spaced so that the watts per square foot of floor surface is 3.5. Values of 20 foot-candles are obtained on the working plane. C. A. M.

204. Recreational Lighting.

Anon. Light, V., No. 4, pp. 41-45.

Recommendations, with detailed diagrams, are given of the type of lighting equipment necessary for almost every indoor and outdoor pastime. C. A. M.

205. Arched Ceiling and Indirect Lighting.

Ward Harrison. Light, V., No. 4, pp. 20-31, April, 1936.

An experimental installation of office lighting in America has indirect fittings, using 250-watt incandescent lamps, directed to a series of sheet aluminium-covered parabolic arches in the ceiling. More than 50 foot-candles are obtained on the working plane from the use of nine such fittings. C. A. M.

VI.—MISCELLANEOUS.

206. How Darkness Kills.

Anon. Elect. World, 106, p. 2051, July 4, 1936.

Statistics are produced showing that in America, while the number of road fatalities during the daytime is decreasing, the number occurring at night is increasing steadily. A section of the report of a New York State Committee, recommending and emphasising the importance of highway lighting, is quoted. S. S. B.

207. Weather to Order from Ageing Machine.

Geo. A. Posner. Elect. World., 106, p. 2228, July 18, 1936.

A short description is given of a piece of apparatus designed to give a forced ageing test, equivalent to weathering under any kind of outdoor conditions. A carbon arc is used to simulate sunlight, and temperature and humidity controls are included. S. S. B.

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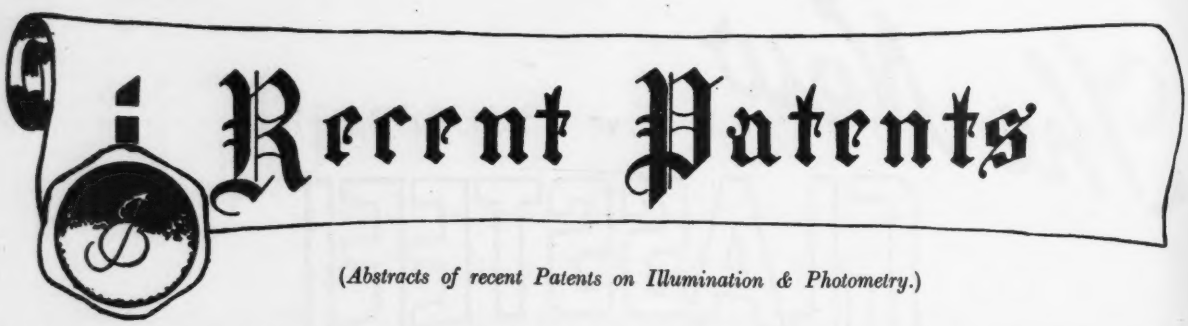

(Abstracts of recent Patents on Illumination & Photometry.)

No. 448,280. "Improvements Relating to Electric Discharge Lamps."

Siemens Electric Lamps and Supplies, Limited, and Aldington, J. N., January 22, 1935.

When hot cathode high-pressure vapour lamps are switched off some time elapses before the pressure becomes low enough to allow the lamp to restart.

In order to avoid inconvenience owing to a temporary or accidental interruption of such a lamp, according to this specification, an additional source of illumination not subject to a delay in starting and a thermally operated switch are provided. When the discharge lamp circuit is interrupted the thermally operated switch closes and, on resumption of the current supply, the additional source of illumination operates until the discharge lamp ignites, when the thermally operated switch is again heated to interrupt the supply to the additional source. The thermally operated switch may be heated by the current through the discharge lamp.

No. 448,706. "Improvements in or Relating to Electric Discharge Lamps."

The British Thomson-Houston Company, Limited, and Davies, L. J, December 12, 1934.

This specification relates to lamps in which the discharge starts as a glow discharge and develops into an arc discharge having a restricted luminous column of high intrinsic brilliancy. In such lamps the position of the ionised column of gas carrying the discharge may be determined by forces such as those arising from convection currents and magnetic fields. Such lamps, however, usually have a negative resistance characteristic and thus require a ballast resistance or inductance in their circuit.

According to the specification the necessity for a ballast resistance may be obviated in a lamp having a low work function cathode, and one or more anodes arranged in proximity to one another by a magnetic field arranged so as to develop and lengthen the arc formed during operation. The magnetic field may be provided by a solenoid energised by the arc current, and, as the current tends to increase, the force acting upon the arc is increased to lengthen the arc and to increase the voltage drop over the arc.

No. 449,031 "Improvements Relating to Electric Discharge Tubes, Particularly Gas-filled Luminous Tubes."

Schallreuter, W. L. W., December 20, 1934.

This specification relates to discharge devices having a filling of one or more common gases or vapours, and at least one relatively inert gas, such as hydrogen, helium, neon, argon, krypton or zenon, and has for its object to prevent the clean-up in operation of the gas-filling, so that the characteristic glows of the several gases may be used throughout the life of the lamp. The lamp comprises a positive column or arc portion which is separated from a portion wherein the cathode negative glow takes place by a capillary constriction. The inert gas takes part in the cathode glow, and the arc or positive column discharge takes place mainly in the common gas, and the diffusion of the latter to the cathode is greatly retarded by the capillary constriction, so that the common gas is not quickly cleaned up by the cathode in operation.

No. 448,799. "Improvements in and Relating to Lanterns for Electric Lamps."

The British Thomson-Houston Company, Limited, Wood, C. W., and Tuppen, C. B., December 14. 1934.

This specification covers a lantern for an electric lamp comprising a cap, which is attached to the suspension of the lamp, and a canopy suspended from the cap and enclosing the lamp, wherein a plate is interposed between the cap and canopy and overlies the top of the canopy to prevent moisture passing from the inside of the cap to the inside of the canopy. The plate is preferably domed to cause any water from the inside of the cap to drain outwards beyond the edge of the canopy. The plate also has insulated terminals mounted in it for leading current to the lamp.

No. 448,887. "Improvements in Luminous Electric Discharge Devices."

The General Electric Company, Limited (communicated by Patent Treuhand-Gesellschaft für Elektrische Gluhlampen m.b.H.), January 3, 1935. *(Addition to No.* 445,187.)

The Parent Patent, No. 445,187, deals with discharge devices in which two luminescent materials are associated with a tube, a primary luminescent material excited by the radiation of the discharge and a secondary luminescent material excited by the radiation of the primary luminescent material.

According to this specification a translucent jacket surrounds both the discharge tube envelope and the first luminescent material and also contains the second luminescent material. The jacket is preferably liquid- or gas-tight, and it may be coloured.

No. 448,891. "Improvements Relating to Electric Discharge Lamps."

Siemens Electric Lamps and Supplies, Limited, and Aldington, J. N., January 22, 1935.

This specification relates to hot cathode discharge lamps of the kind in which an electrode is heated by a discharge between itself and an auxiliary electrode included in a starting circuit which, with the auxiliary discharge path, is shunted across the main electrodes. The starting circuit includes contacts which are controlled by a thermal switch operated by the heat generated in the lamp so that, when the lamp heats up in operation, the starting circuit is interrupted.

No. 448,904. "Improvements in and Relating to Photo-Electric Photometers."

Holophane, Limited, English, S., Everett, Edgcumbe and Company, Limited, and Edgcumbe, K., February 27, 1935.

This specification covers a photo-electric photometer having a manually operable resistance control for applying one or more colour correction factors to the galvanometer readings, so that the galvanometer reads directly in units of light intensity, or multiples thereof, irrespective of the colour of the light, when the control is set to the appropriate position for the colour of the light being measured. Variable resistances may be connected directly in the galvanometer circuit in series and/or in shunt. Various net-works are described.

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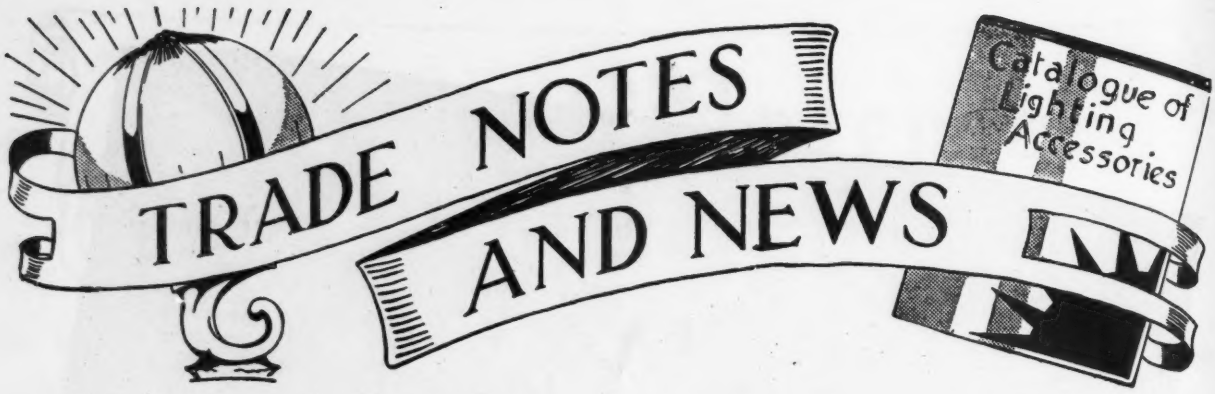

Public Lighting in Birmingham

We hear that nearly £100,000 is to be spent on improving the lighting of Birmingham's main traffic thoroughfares. The scheme will ultimately involve the provision of nearly 4,000 mercury vapour electric discharge lamps and affects nearly 200 miles of roads in the city, about a quarter of Birmingham's total road mileage. Three types of lamps of the latest design are to be used, ranging from 400-watt lamps on double carriageway roads to 150 watts on narrower roads. An important feature of the scheme is the provision of "graded" lighting along all roads leading into arterial roads. The dangers arising when a driver passes from a brilliantly lighted road into one where a much lower standard of illumination is in use will be avoided by arranging for the illumination on side roads to be diminished gradually for the first 100 yards after leaving the main thoroughfare.

Recent Gas Lighting Contracts

Under a new public lighting contract the streets of Fairford will be lighted by gas for a period of five years. Previous contracts have been for one year only.

About 288 gas lamps are involved in a new contract affecting the lighting of Braintree and Bocking.

Following on a five-year contract a ten-year agreement for gas lighting has been entered into by the Stamford Corporation. Over 300 lamps are involved. The contract embodies a clause providing for a sliding scale of prices should the price of gas fluctuate.

Other recent contracts for gaslighting have been arranged in Dungannon, Long Melford (Suffolk), High Bentham (Lancs.), Totnes (Devon), Knottingley (Yorks.), Ledbury, and Burgess Hill (Sussex).

Elm Works, Ltd.

We have received catalogues from Elm Works, Ltd., illustrating the gas and electric street lighting fittings and vitreous enamelled reflectors, cooker enamels, etc., manufactured throughout at this works.

Mr. Charles H. A. Kempton is now managing director, and under his management considerable extensions are being planned and further up-to-date plant installed.

This works was originally founded by the Welsbach Light Co., Ltd., about 1895, and has since continuously manufactured street lighting lamps, lanterns, reflectors, etc.

Night View on a Dry Road

Street lighting by 250-watt Osira high pressure mercury vapour electric discharge lamps housed in G.E.C. di-fractor lanterns at Anlaby-road, Hull.

These are spaced at 160 ft. intervals, every third standard carrying two lanterns suspended from a

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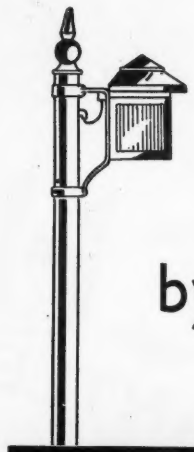
with many varieties of jointing and fixing and special attention has been paid to the joints. The illustration shows Type WA with base WCB, two 15 in. arms and reflector RG for 60-watt lamps.



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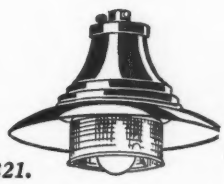

STAND No. 2

A.P.L.E. EXHIBITION, CHELTENHAM.

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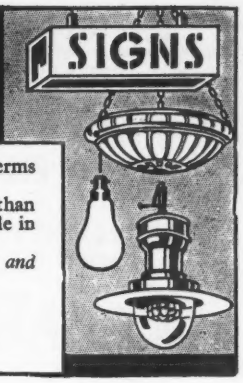

We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3¼ inches wide) are given below.

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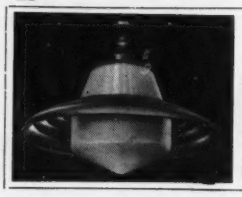

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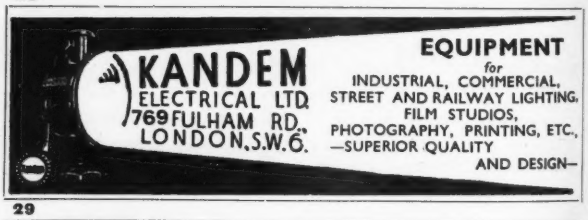

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Catalogues and Advertising Literature

We invite all firms in the Lighting Industry to send us new catalogues as they appear, for reference in these columns.

BRITISH THOMSON-HOUSTON CO., LTD. (Crown House, Aldwych, London, W.C.2). Catalogue of Mazda Light Tubes (Illustrated Booklet). Mazda Lamp Catalogue (50 pages).

CRYSELCO, LTD. Electric Lamps (Illustrated Catalogue).

ELM WORKS, LTD. Gas and Electric Street Lighting Fittings (Illustrated Catalogues).

GENERAL ELECTRIC CO., LTD. Miniature and Industrial Measuring Instruments (Two Illustrated Catalogues, M.1. and M.2).

KANDEM ELECTRICAL, LTD. Arc Illuminators and Arc Spots, and Incandescent Illuminators (Illustrated Leaflets Nos. F. 101 and E. 200).

POLES, LTD. "Adastra" Sectional Steel Poles (96 pp. illustrated leaflet No. F. 100).

SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD. Benjamin Reflector Fittings and Lighting Specialities (Catalogue No. 492).

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"LUX"
(La Revue de l'Eclairage)

WE have pleasure in announcing to our readers that we have entered into an arrangement to receive subscriptions for the French Journal "Lux" (La Revue de l'Eclairage). The subscription per annum is 30 francs, the approximate equivalent of which in English money is Seven Shillings and Sixpence (7/6).

"Lux" is the only French journal which specialises in all aspects of lighting; it is the official organ of the Association Française des Ingenieurs de l'Eclairage (equivalent to the Illuminating Engineering Society in France).

It furnishes a complete record of interesting developments in lighting in France and on the Continent. It is fully illustrated and in particular devotes a considerable number of its pages to Decorative Lighting.

By studying these articles and the numerous photographic reproductions of modern lighting installations the reader can readily gain an excellent impression of French methods and practice in matters of Illumination.

Applications for subscriptions will be received by "Light and Lighting," 32, Victoria Street, London. S.W.1.

IMPORTANT NEW GAS LIGHTING CONTRACTS FOR LONDON

Westminster, Holborn, Paddington, Southall-Norwood—and now Chelsea. The list of 15-year contracts embodying gas for street lighting in London boroughs is steadily growing. Chelsea's new agreement affects the lighting of the side streets in the Borough and that on thirteen main traffic routes. By the addition of special reflective devices and the raising of the candle power of existing lamps, the illumination of all side streets will be doubled; while the lighting of the main roads will be brought up to the standard laid down by the interim report of the Ministry of Transport Departmental Committee on Street Lighting.

Another important contract signed this year for gas lighting in London affects about 106 miles of roads in Wandsworth. The agreement is for a period of 5 years and the system employed will be high-pressure gas lighting for main roads and low pressure for the remainder. The new lamps are to be installed at the rate of 270 a week until the remodelling of Wandsworth's lighting is completed. About 5,000 modern gas-lamps will be fixed under the scheme of modernisation.

Among the many 1935 and 1936 contracts which specify the use of gas for public lighting may be mentioned the following:—

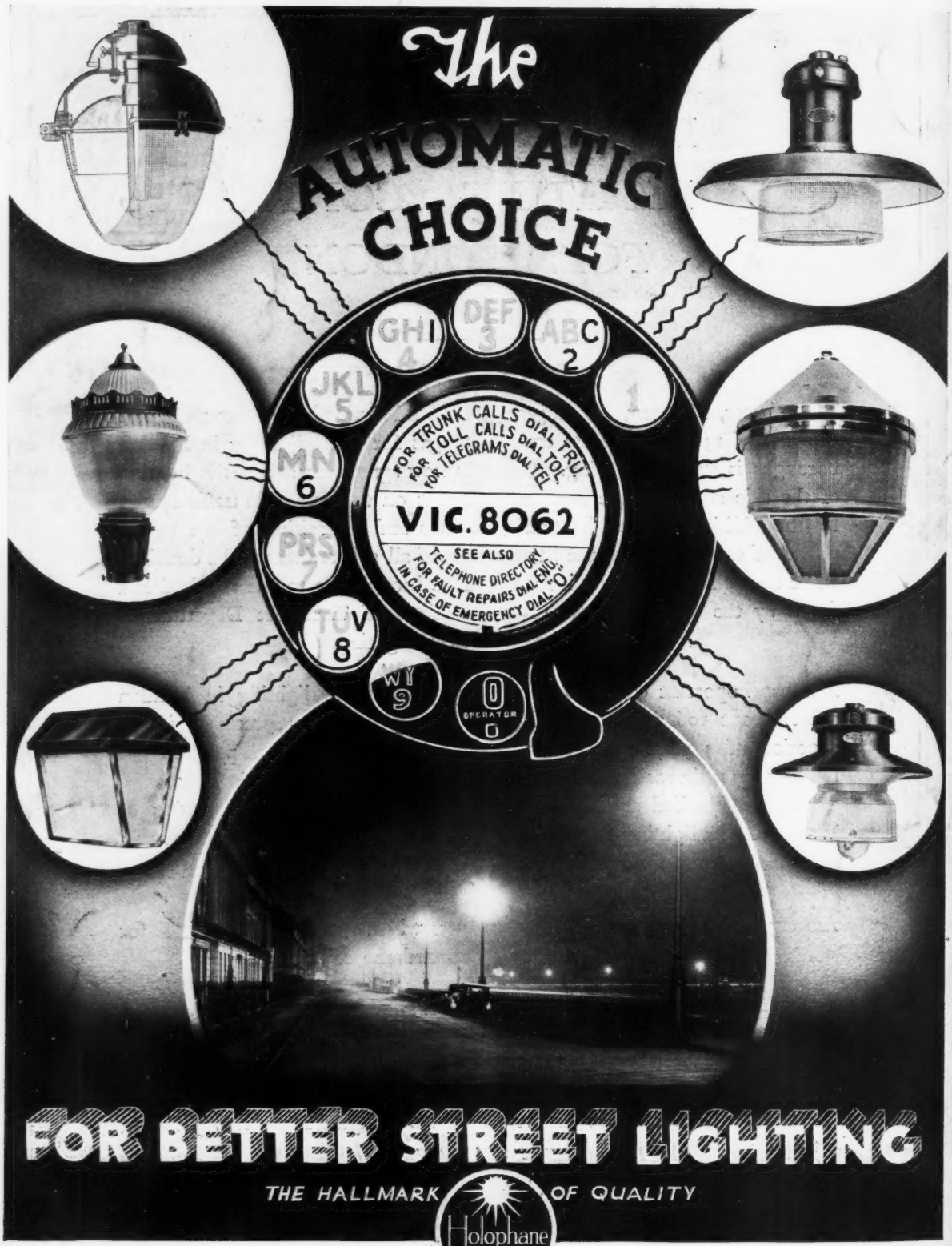
15-YEAR CONTRACTS: *Southall-Norwood, Whitstable, Hendon, Dagenham.*

10-YEAR CONTRACTS: *Ruislip-Northwood, Ilfracombe, Cambridge, Blyth, Northampton, Southwark, Penge, Margate.*

7-YEAR CONTRACTS: *Harrow, Wanstead-Woodford, Farnhill, Brightlingsea, Selkirk, Hatfield.*

5-YEAR CONTRACTS: *Welshpool, Budleigh Salterton, Deal, Wembley, Brentwood, Falmouth, Walton-on-Thames, Diss, Egham, Kidwelly.*

ISSUED BY THE BRITISH COMMERCIAL GAS ASSOCIATION, 28, GROSVENOR GARDENS, LONDON, S.W.1.



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